SPERRY RAND

UNIVAC 9400 SYSTEM

Program Description Drawing

CUSTOMER ENGINEERING

4091646

SPERRY RAND UNIVAC

DRAWING NO. 4091646

REVISION C

CUSTOMER ENGINEERING
PRODUCT DIAGNOSTIC SOFTWARE

9400 - XII/XVI Mag. Tape Subsystem Timing and Graphing Test T5017T

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DWG REV	MSTR REV	RELEASE DATE	DESIGNER NAME	EIR NUMBER	FCO NUMBER
-	B	4/4/69	R. R. Graham	A89792	A30190017
A	C	5/28/69	R. R. Graham	A89793	A30190020
B	E	8/25/69	D. L. Bingen	A89795	A30190024
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REVISION DESCRIPTION RECORD -4091646

REV	DESCRIPTION
-	Initial Release
A	Added new device numbering scheme and changed the program load name from "TT5Ø17" to "T5Ø17T".
B	1108 to 9400 Assembler Conversion. Modify to allow for pre-parameterization, test now prints graph of Test 3 via PMR and corrected stop on error option so that test stops before attempting error recovery.
C	Conform graphs to Univac standards.

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1.0 INTRODUCTION

1.1 Purpose - This document describes the 9400 Maintenance Timing and Graphing Test for the UNISERVO XII/XVI Magnetic Tape Subsystem.

1.2 Major Objectives - The objective of this test program is to perform a timing measurement of the UNISERVO XII/XVI Magnetic Tape Subsystem. Test organization and operator options are intended to satisfy the needs of Design, Quality Control and Field Engineering personnel in checkout, acceptance, and maintenance activities.

1.3 Equipment Configurations - All equipment configurations must be connected to the Selector I/O channel(s) of the 9400 processor. This test will operate the following equipment configuration:

- XII/XVI Control/Handler 9-Track Type 5017-00,01
- XII Master Unit 9-Track Type 0861-00,02
- XII Slave Unit 9-Track Type 0861-01,03
- XII Master Unit 7-Track Type 0861-04,06
- XII Slave Unit 7-Track Type 0861-05,07
- W/R, R/R Simultaneity Feature 1600 bpi Phase Type 0861-00,02 Feature F0939-00
- *Dual Density - 1600 bpi Phase/800 bpi NRZI Type 0861-00,02 Feature F0935-00
- W/R, R/R Simultaneity - 1600 bpi Phase; 800 bpi NRZI - Non-Simultaneous Type 0861-00,02 Feature F0934-00 and F0935-00
- *W/R, R/R Simultaneity - 1600 bpi Phase; 800 bpi NRZI Type 0861-00,02 Feature F0934-00,01 and F0935-00
- W/R, R/R Simultaneity - 200, 556, 800 bpi NRZI Type 0861-04,06 Feature F0934-02
- XVI 9-Track Type 0862-00,01
- XVI 7-Track Type 0862-02,03
- W/R, R/R Simultaneity Type 0862-00,01 Feature F0936-00
- Dual Density - 1600 bpi Phase/800 bpi NRZI Type 0862-00,01 Feature F0937-00
- W/R, R/R Simultaneity - 1600 Phase/800 bpi NRZI Type 0862-00,01 Feature F0936-00 and 0937-00.
- W/W, W/R, R/W, R/R Simultaneity - 1600 bpi Phase/800 bpi NRZI Type 0862-00,01 Feature F0936-00, 0936-01, 0937-00
- W/R, R/R Simultaneity - 200, 556, 800 bpi NRZI Type 0862-02,03 Feature F0936-00
- W/W, W/R, R/W, R/R Simultaneity - 200, 556, 800 bpi NRZI Type 0862-02,03 Feature F0936-00, 0936-01

* Capability for 200, 556, 800 bpi NRZI exists if UXII - 2 Type 0861-05,07 is within the bank.

1.4 Associated Software - This program relies on the Maintenance Control Routine (MCR) to perform program load, parameterization, execution, deletion, and I/O handling.

1.5 Reference Documents - Documents used as reference material during the development of this test program are listed below.

Drawing	Rev.	Description
S-70040		NCF-H Processor and Console Product Description
P-12151		NCF-H System Product Description
4091622		9400 Maintenance Control Routine
	-	9400 Bootstrap Assembler on 1107/1108.
4096482	C	Documentation Standard for Engineering Programming Publications.
4096483		General Parameter and Message Standard for Test Programs.
4096484		9400 Maintenance Systems Guidelines Document
4091623		9400 Parameter and Message Routine Program Description Drawing
4091624		9400 Standard Subroutines
P-10054	C	UNISERVO 12/UNISERVO 16 Subsystem - Type 5017-XX
4091650	2	9400 0858 VI-C Magnetic Tape Subsystem Timing and Graphing Test Program Description Drawing.
4091647	1	9400 5017 XII/XVI Magnetic Tape Subsystem Test Program Description Drawing.

1.6 Restrictions -

Since the XII/XVI Graphing Test must use the high speed printer for its output media, any concurrently running printer tests must be suspended before the graphing test is made available to this program.

This MAR does not test the ability of the XII/XVI units to read and write data accurately or to execute commands correctly. It is designed only to measure the mechanical characteristics of the servos. For this reason it is recommended that the control unit test of T5Ø17T (Drawing 4091647) be run prior to the tests described in this document.

The timer must be enabled from the maintenance panel for all tests.

The address of the High Speed Printer is obtained from MCR rather than through parameter entries.

Tape Speed is assumed to be a constant value of 42.7 inches/sec for the UNISERVO XII and 12Ø.Ø inches/sec for the UNISERVO XVI.

The time necessary to pass the pre-amble and post-amble (Phase Recording Mode) has been calculated to be 600.1 μs for the UNISERVO XII and 213.5 μs for the UNISERVO XVI.

2.0 FUNCTIONAL DESCRIPTION

2.1 General Organization - This MAR uses three operator-selectable tests to measure the timing characteristics of a UNISERVO XII/XVI Magnetic Tape Subsystem. The program cycles these tests under various conditions which are selectable by the operator via parameter entries. If an error is detected, an error printout is automatically generated unless Option V1 has been deleted from the test program. The Read-Stop time curve will be displayed on the Model Ø768 Printer.

As soon as the initial parameters have been selected, the control section is entered and immediately checks for a test in progress. If a test is running, the control section will select the next subroutine, provided that the assigned device is still available. After a device has been completely tested (all the subroutines have been applied), it is flagged as done and the program is recycled to check its tables for another available device.

After all selected devices have been run by the initial test, that test is flagged as finished, the indicated devices are reactivated, and the program is recycled. When all the selected tests are flagged as finished, the MAR is repeated or suspended, depending on whether or not the Cycle Option (V14) has been entered.

All tests are capable of running on a 7-Track device. A Standard Mode Set Command which sets a condition of 800 bpi NRZI, odd parity, and Data Converter and Translator "off" is issued prior to each test. This command will be ignored by 9-Track devices.

2.2 Test Descriptions - Each of the following tests is described by stating its objective and the method used to attain it.

2.2.1 Test 1 (Group Test) -

Objective - The objective of Test 1 is to enable both Test 2 and Test 3 to be internally selected simply by entering Test 1.

Method - The program parameter routine will internally select and make available Test 2 and Test 3 when it encounters Test 1.

2.2.2 Test 2 (Timing Test) -

Objective - This test is designed to measure the Forward Stop Distance, the Forward and Backward Start times, and the Forward Creep Distance. The test also measures the interblock gap distances created as a result of running in both Start-Stop and Non-Stop Modes.

Method - The test uses the Timing Mode of operation which will allow it to measure all times by adding the execution times of a series of loop instructions. The test enters the "loop" at the start of an I/O operation and exits from the loop when the first byte of data enters the input buffer.

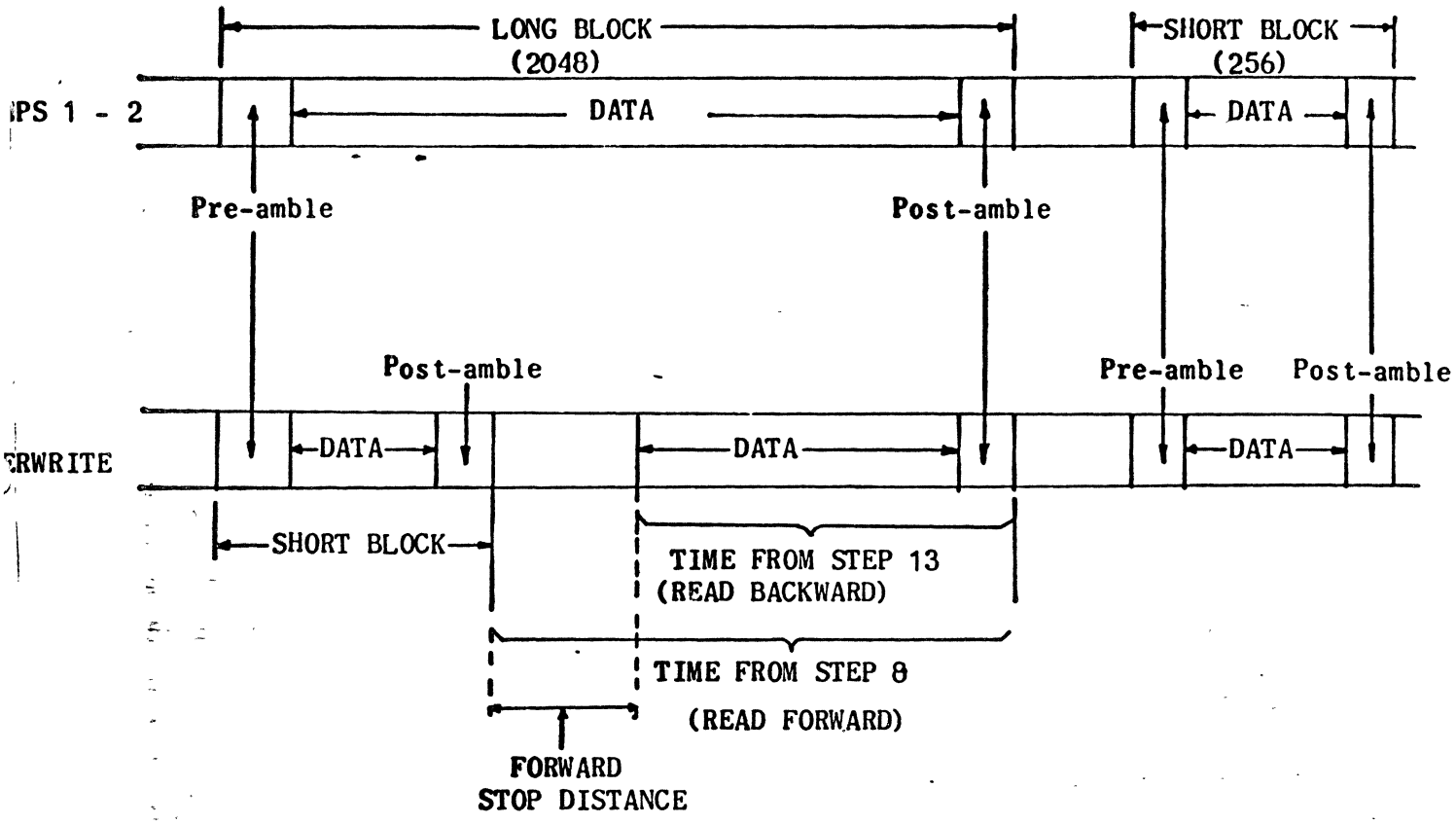
A sentinel byte is used as the first and last data byte in each block written. All the sentinel byte locations in the input buffer are cleared prior to each read function.

The MAR uses both the Kind number (either 8 or 9) and the Feature number ("1" for 7-Track) in calculating the timing measurements. The Kind number will give the tape speed and the Feature number will indicate whether or not a pre-amble and a post-amble have been written. If the device is 9-Track, the MAR must consider the time necessary to pass the pre-amble and the post-amble and then subtract this time from that which was summed up in the loop. But if a 7-Track device is being tested, no subtraction is necessary because the Phase Mode does not record pre- or post-amble on this device.

The first measurement made by the MAR is the Forward Stop Distance. The procedure used is shown below.

1) Write a 2048-byte block.
2) Write a 256-byte block.
3) Backspace two blocks.
4) Write a 256-byte block, overwriting part of the 2048-byte block.
5) Backspace block.
6) Read short block.
7) After interrupt from short block, issue a Read Command for the remainder of the long block and enter "loop".
8) Exit from "loop" when the interrupt from the long block occurs and save the time calculated.
9) Issue a Read Command.
10) Issue a Read Backward Command.
11) After interrupt from Read Backward Command issue a Read Backward Command for the overwritten 2048 byte block and enter Wait Subroutine.
12) Exit from Wait Subroutine when the first byte of data (sentinel byte) enters the input buffer and enter "loop".
13) Exit from loop when the interrupt from the long block occurs.
14) Subtract loop time calculated in Step 8 from that calculated in Step 13. Multiplying this difference by tape speed gives the Forward Stop Distance in inches.

The following illustration may belp to make the above procedure more clear (shown in Phase Recording Mode)



The test rewinds the tape in use and measures the Forward Start-Stop gap distance using the following method:

1) Write two 256-byte blocks of data in Start-Stop Mode.

2) Backspace twice.

3) Read one block.

4) After interrupt, immediately issue another Read Command and enter timing loop.

5) Exit from loop when the first byte of data (sentinel byte) enters the input buffer and obtain time.

6) Multiply time by tape speed to obtain gap distance in inches.

The test then proceeds to measure the Backward Start Time in the following manner:

1) Write two 256-byte blocks of data in non-stop mode.

2) Read Backward one block and wait for tape motion to stop.

3) Issue a Read Backward Command and enter timing loop.

4) Exit from loop when the first byte of data (sentinel byte) enters the input buffer and obtain Backward Start Time in milliseconds.

The test next measures the non-stop gap in the backward direction by the following method:

1) Space forward two blocks.

2) Read one block backwards.

3) After interrupt, immediately issue another Read Backward Command and enter timing loop.

4) Exit from loop when the first byte of data (sentinel byte) enters the input buffer and obtain time.

5) Multiply time by tape speed to obtain gap distance in inches.

The non-stop gap is now measured in the forward direction using the following method:

1) Read one block of data.

2) After interrupt, immediately issue another Read Command and enter timing loop.

3) Exit from loop when the first byte of data (sentinel byte) enters the input buffer and obtain time.

4) Multiply time by tape speed to obtain gap distance in inches. This distance will be saved for future reference.

The test next measures the Forward Start Time for the previously written non-stop gap by the following method:

1) Backspace two blocks.

2) Read one block of data and wait for tape motion to stop.

3) Issue Read Command and enter timing loop.

4) Exit from loop when the first byte of data (sentinel byte) enters the input buffer and obtain Forward Start Time in milliseconds.

The Forward Creep Distance is the final measurement made in this test. The following procedure is used:

1) Backspace and overwrite (a total of ten times) the second block which was previously written in non-stop mode.

2) Backspace two blocks.

3) Read one block of data.

4) After interrupt, immediately issue another Read Command (to the block which has been overwritten ten times) and enter timing loop.

5) Exit from loop when the first byte of data (sentinel byte) enters the input buffer and obtain time.

6) Multiply time by tape speed to obtain gap distance in inches.

7) Subtract from this distance the previously saved non-stop gap distance. Difference is total creep for the ten overwrites.

8) Divide result by ten, giving the Forward Creep Distance in inches per overwrite.

2.2.3 Test 3 (Graphing Test -

Objective - This test is designed to measure the Forward and Backward Read Start Time and print out a graphical presentation of the result on the high speed printer.

Method - This test uses the Timing Mode of operation in a fashion similar to Test 2, except that a variable delay loop is entered before the second read. The sequence used is shown below.

1) Write a 256-byte block and wait for tape motion to stop.

2) Write 210 256-byte blocks in Non-Stop Mode.

3) Rewind tape.

4) Read first 256-byte block and wait for tape motion to stop.

5) Issue Read Command.

6) When interrupt is generated, a delay routine is entered. The delay varies from 3.2 to 17.8 milliseconds, in multiples of 104.4 μs.

7) The next Read Command is issued and a counter measures the time from the issuance of the command until the first data byte (sentinel byte) enters the input buffer.

8) The delay steadily increases through 120 consecutive measurements.

9) The result is the Forward Read-Stop curve done once. The Backward Read-Stop curve is done in the same way with two exceptions:

a) The Read Backward Command is issued instead of the Read Forward Command.

b) The delay starts at a maximum value and decreases to a minimum value.

3.0 OPERATING PROCEDURES

3.1 Initialization - Pre-test setup consists of the following:

- Load the Maintenance Control Routine (MCR).
- Mount blank tapes on all the UNISERVO XII/XVI Tape Units to be tested (maximum of 16 units).

3.2 Program Loading - The procedure for program loading is as follows:

- Press the ATTENTION key. The console responds with the @ sign, the time stamp, a space and then waits for an input message.
- Type in "RU". The console responds by printing an "N" adjacent to the "RU" followed by a space.
- Type in program name as follows:

  T5Ø17T

- Press the EOM key (symbol ®). The load and run statement which initiates loading and running the program appears on the console in the following format:

  @ØØ:18 RUN T5Ø17T®

- When the program has been loaded, the MCR prints a message which indicates the program's job number and the starting address of the test program.

  JOB 1, T5Ø17T LOADED AT 2A48

3.3 Program Starting - The program is started by the MCR as soon as it is loaded. When the program is started, it types out the message:

*A ØØ:19 1 T5Ø17T ENTER PARAMETERS

and waits for a parameter entry. Parameters are entered in the format described in Paragraph 3.4.1 using the procedure described in Paragraph 3.4.

3.4 Program Modifying - The program is adjusted to operate a specific configuration in various operating modes by entering unsolicited parameters.

The parameter entry procedure is as follows:

- Press the ATTENTION key. The console responds with an @ sign and a time stamp (@ Ø2:27) and waits for a run identifier entry.
- Type in the one-digit job or run number and a comma. A job number entry must be made within two minutes after the ATTENTION key was pressed or an abort type-out will occur. An example of an entry statement to this point is shown below:

  @Ø2:27 1,

- Enter up to 63 characters of parameter data ending the statement by pressing the EOM key. An operator must enter all data following the comma within two

minutes or an abort message will be printed.

- Enter the needed parameters, then begin the program by entering a Begin Action Designator. The Begin designator may be entered in two ways: in a separate statement, or as a separate sentence in a parameter entry statement. An example of each is shown below.

  @ ØØ:5Ø 1,B@

  @ ØØ:5Ø 1,A C1 T3:#GEØ K8.B@

3.4.1 Parameter Entries - Parameter statements are entered in the general format shown below.

d Cn Vn Tn:#Ann Kn Fn@

Where:

d = An Action Designator

Cn = Channel number (n) of the desired Selector I/O Channel.

Vn = Number of variables (program options to be selected).

Tn = A number or group of numbers indicating what tests are to apply to the subsystem.

Ann = A three-character device address consisting of, in order, the alpha character (arbitrarily assigned) which designates the subsystem's control unit, a hexadecimal number (1-F) which is the subchannel address of the control unit, and a hexadecimal number (Ø-F) which specifies a selected device (unit) in the subsystem.

Fn = A Feature (1) which applies to the device.

Kn = A Kind number (8 or 9) which applies to the device.

@ = End-of-Message Symbol.

3.4.2 Parameter Notes and Restrictions -

1. Variable one (V1) applies to equipment error messages only. It does not apply to parameter errors or program status messages.
2. A period (.) is used to separate parameter sentences.
3. The colon (:) must be used to separate devices from the rest of the parameter statement.
4. A semicolon (;) is used to separate UNISERVO XII, UNISERVO XVI, and 7-Track devices within one parameter statement.

   Example: ....:#KEØ K8;#KE2 K9;#KE3 K9 F1@

   XII XVI XVI 7-Track

5. In a parameter entry, each three-digit device number (Ann) is preceded by a number sign(#).

6. The test program does not recognize any extension on the Action Designators B (Begin) and V (View).

7. The Action Designator D® deletes all devices and tests and resets the program variables to the values they contained at load time:

```
Allow Error Printout
Allow Error Recovery Three Times
Do Not Stop on Error
Send All Error Messages to the Console
```

8. The Action Designator B® (Begin) must be used to get the program initially started. When used to restart the test program, it will reset all selected devices and tests to an available state.

9. The Action Designators E (Suspend) and R (Resume) can be extended to apply to specific devices and/or tests as shown below.

Example:
```
E T2® (Suspend Test 2)
R T3:#NEØ® (Resume Test 3 and Device Ø)
E T2.R:#NEØ-1® (Suspend Test 2 and Resume Devices Ø-1)
```

10. To change subchannels, the operator deletes all devices on the subchannel presently entered and adds all desired devices on the new subchannel.

Example: D:#NEØ-4.A:#NAØ-7®

11. To determine the present test parameters, enter the Action Designator V® (View). This entry will display on the console the parameters present in the test program in the general format shown below.

Example:
```
I ØØ:ØØ 1  T5Ø17T  **VIEW**
Cn
Sn
Vn,n...n
Tn,n
: Ann/F1/Kn;...
```

Where:
- Cn = Present Selector Channel number
- Vn = Present Variables
- Tn = Present Tests
- Ann = Present Devices
- /F1 = Specific device is a 7-Track device (not present if 9-Track)
- /Kn = Present Kind number assigned to the specific device

Example:
```
I  ØØ:ØØ 1 T5Ø17T  **VIEW**
C1
S14
V1,3
T2,3
:NEØ/K8;NE1/K8;NE2/K8;NE3/K8;NE4/K8;NE5/K8;NE6/K8;NE7/F1/K9
```

3.5 Program Stopping - The test program can be stopped by one of the following entries:

- A parameter entry having the following format:

  E⊙ - -

  This entry will cause the test program to suspend without console indication.

- A parameter entry having the following format:

  D⊙

  This entry will clear all test parameters and cause the test program to suspend itself with the following console indication:

  A hh:mm 1 T5Ø17T NO TESTS SELECTED

  This message will also be displayed when all selected tests have been completed and the Cycle Option (V14) is not entered.

- Encountering an error with the Stop On Error variable (V4) entered will cause the test program to suspend itself with the following console indication:

  D hh:mm 1 T5Ø17T STOPPED ON ERROR

- A major subsystem error will halt the test program whether or not Stop On Error variable is entered.

3.6 Program Restarting - The test program can be restarted by one of the following entries:

- A parameter entry having the following format:

  B⊙

  This entry will restart the test program from its initial starting point.

- A parameter entry having the following format:

  R⊙

  This entry will restart the test program at the point at which it was stopped. It can be used if the test program has been suspended by the E⊙ type-in or if it has stopped on error (V4 entered).

3.7 Program Termination - The program may be removed from storage by submitting a cancel directive to the Maintenance Control Routine. Enter the cancel directive as follows:

- Press the ATTENTION key on the console. The console responds with an @ sign and a time stamp (@Ø7:Ø7) and waits for another entry.
- Type in the letters "CA". The console responds by printing an "NCEL" followed by a space.
- Type in the job identifier followed by the EOM key (symbol ⊙). A complete example of a cancel directive is as follows:

  @ Ø7:Ø7 CANCEL 1 ⊙

3.8 Program Designators - The parameter designators recognized by this test program are grouped into the following three categories:

- Action Designators
- Equipment Designators
- Test Designators

3.8.1 Action Designators - The Action Designators specify how the Parameter Analysis Routine of the test program will process the desired parameters. The following Action Designators are recognized by this test program:

A = Add

B = Begin

D = Delete

E = Suspend

R = Resume

V = View

3.8.2 Equipment Designators - The Equipment Designators define the particular UNISERVO XII/XVI Tape Subsystem being tested. The following Equipment Designators are recognized by this test program:

Cn = One-digit channel number (1 or 2) of the UNISERVO XII/XVI Subsystem being tested.

Ann = A three-character device address consisting of, in order, the alpha character (arbitrarily assigned) which designates the subsystem's control unit, a hexadecimal number (1-F) which is the subchannel address of the control unit, and a hexadecimal number (Ø-F) which specifies a selected device (unit) in the subsystem.

Fn = A number (1) indicating that the specific device associated with this feature is a 7-Track device. This entry will eliminate subtracting the time necessary to pass the Phase Recording preamble which is not recorded on a 7-Track device.

Kn = A Kind number (8 or 9) indicating that the specific device is either a UNISERVO XII (Kind 8) or a UNISERVO XVI (Kind 9). This entry is used to determine whether the tape speed is 42.7 in/sec. (Kind 8) or 120.0 in/sec. (Kind 9).

3.8.3 Test Designators - Test designators are parameters which modify the MAR's testing procedure. The following test designators are recognized by this test program:

Tn = A number or group of numbers indicating the tests which apply to the subsystem.

Where: T1 = Group Test
T2 = Timing Test
T3 = Graphing Test

Vn = A number or group of numbers (1,3,4,7 or 14) indicating the variables which apply to the subsystem.

Where: V1 = Allow Error Printouts (available on load).

V3 = Allow Error Recovery Three Times (available on load).

V4 = Stop On Error

V7 = Direct Error Messages to High Speed Printer.

V14 = Cycle on selected tests.

No extensions of these variables are recognized.

3.9 Message Description -

3.9.1 General - If the UNISERVO XII/XVI Test program detects an abnormal condition in the hardware status or if insufficient parameters are entered, it informs the operator via a console message. If Variable Seven (7) has been entered and a High Speed Printer is available, the message will be displayed on the printer. The graph will always appear on the printer. Essential messages will always be directed to the console.

3.9.2 General Format Information - The mnemonics and symbols used in the messages described in 3.9.3 are defined in the following paragraphs.

3.9.2.1 Mnemonics -

CS = Current Status

ES = Expected Status

D = Declarative Message

I = Imperative Message

A = Answer Message

SB = Sense Bytes

Sn = Subchannel (n)

Cn = Channel (n)

Tn = Test (n)

Dn = Device (n)

EA = Expected Address

RA = Received Address

CC = Current Command

CD = Condition CoDe

CAW = Channel Address Word

CSW = Channel Status Word

OPSW = Old Program Status Word

NSD = No Sense Data

T5Ø17T = Program Name (Magnetic Tape 5Ø17 Timing Test)

3.9.2.2 Symbols -

hh = Hour (ØØ-23)
mm = Minute (ØØ-59)
r = Run number (1-8)
n or nn = Numerical value of mnemonic prefix

3.9.3 Messages - All messages originating from the test program fall into one of three groups: Parameter Errors, Subsystem Errors, and Information Messages. Each type is described below.

3.9.3.1 Parameter Errors - A parameter error is caused by the detection of insufficient parameters by the MAR. Upon detection, the program prints the appropriate message from the list shown below and then waits for additional parameter entries.

1) No Tests

Cause: No tests are available for testing. If Cycle Option (V14) is not entered, this message will always appear after completing all selected tests on all selected devices once.

Example: *A ØØ:ØØ 3 T5Ø17T NO TESTS SELECTED

Operator Action: Enter valid test, making sure program has an available device. If Cycle Option (V14) was not entered, and no tests or devices were suspended or deleted, the program can be restarted by entering only B®.

2) No Devices

Cause: Program has no devices selected.

Example: *A ØØ:ØØ 3 T5Ø17T NO DEVICES SELECTED

Operator Action: Enter parameters making certain that a device is available.

3) No Subchannel

Cause: Program does not have a valid subchannel assignment.

Example: *A ØØ:ØØ 3 T5Ø17T NO SUBCHANNEL ENTERED

Operator Action: Enter parameters adding a valid subchannel.

4) No Channel

Cause: Program does not have a valid channel assignment.

Example: *A ØØ:ØØ 3 T5Ø17T NO CHANNEL ENTERED

Operator Action: Enter parameters adding a valid channel.

5) Lacks Kind

Cause: A device was selected but no Kind number was associated with it.

Example: *A ØØ:ØØ 3 .T5Ø17T C1 T2 NEØ DEVICE LACKS KIND

Operator Action: Enter a Kind number for the device specified in the error message.

3.9.3.2 Subsystem Errors - Subsystem errors occur if the status byte, device address, or the sense bytes do not match the expected bytes. Subsystem errors also occur if an incorrect condition code is received after a "Start I/O" Command.

1) Status Error

Cause: The status byte received did not match the status expected.

Program Action: Program will attempt to recover from the error by repositioning the tape and re-issuing the command.

Example:
```
D hh:mm 1 T5Ø17T C1 T3 NEØ      STATUS ERROR
    ES = ØC              CS = ØE
    EA = Ø1EØ            RA = Ø1EØ
    CD = ØØ              CC = Ø1
    SB = Ø84ØØ3AØØØ
```

Operator Action: No operator action is required.

2) Subsystem Not Available

Cause: A "Start I/O" condition code of 3 was received on an MCR-initiated command.

Program Action: The program will stop on error.

Example:
```
D ØØ:ØØ 1 T5Ø17T C1 T3 NEØ     SUBSYSTEM NOT AVAILABLE (NSD)
    ES = ØC              CS = ØØ
    EA = Ø1EØ            RA = Ø1EØ
    CD = Ø3              CC = ØØ
    SB = ØØØØØØØØØØ
D hh:mm 1 TT5Ø17   STOPPED ON ERROR
```

Operator Action: Determine cause of trouble (subsystem is probably Off-Line) and resume the test program.

3) Bad Sense Data

Cause: The status received from an MCR initiated sense command was not normal.

Program Action: Program will type out error message and attempt normal recovery on the original command.

Example:
```
D hh:mm 1 T5Ø17T C1 T2 NEØ      BAD SENSE DATA
    ES = ØC              CS = Ø2
    EA = Ø1EØ            RA = Ø1EØ
    CD = ØØ              CC = Ø1
    SB = ØØØØØØØØØØ
```

Operator Action: No operator action is required.

4) Sense Failed

Cause: A non-zero condition code was received after an MCR-initiated sense command.

Program Action: Program will type out error message and attempt normal recovery on the original command.

Example:
```
D hh:mm 1 T5Ø17T C1 T2 NEØ     SENSE COMMAND FAILED (NSD)
    ES = ØC              CS = ØE
    EA = Ø1EØ            RA = Ø1EØ
    CD = Ø1              CC = Ø1
    SB = ØCØØØØØØØØ
```

Operator Action: No operator action is required.

5) Reposition Error

Cause: Error condition detected while attempting to recover by repositioning tape.

Program Action: Program will suspend the device in error and continue.

Example:
```
D hh:mm 1 T5Ø17T C1 T2 NEØ     REPOSITION ERROR
    ES = ØC              CS = ØE
    EA = Ø1EØ            RA = Ø1EØ
    CD = ØØ              CC = 27
    SB = Ø84ØØ3ØØØØ
D ØØ:ØØ 3 T5Ø17T CØ T2 NEØ     DEVICE SUSPENDED BY PROGRAM
```

6) Address Error

Cause: Interrupt received from different device than expected.

Program Action: Program will type out error message and attempt normal recovery on the original command.

Example:
```
D hh:mm 1 T5Ø17T C1 T2 NEØ     ADDRESS ERROR
    ES = ØC              CS = ØC
    EA = Ø1EØ            RA = Ø1E1
    CD = ØØ              CC = Ø1
    SB = Ø84ØØ3ØØØ
```

Operator Action: No operator action is required.

7) I/O Time-out

Cause: An MCR-initiated I/O command did not get a response from the controller in less than two minutes.

Program Action: Program will stop on error.

Example:
```
D hh:mm 1 T5Ø17T C1 T2 NEØ     I/O TIMEOUT
    ES = ØC              CS = ØØ
    EA = Ø1EØ            RA = Ø1EØ
    CD = FF              CC = Ø1
    SB = ØØØØØØØØØØ
```

Operator Action: Determine cause of trouble and resume the test program.

8) Timing Mode-Status Error

Cause: The status received from the program-initiated Start I/O was not normal.

Program Action: The current test assigned to the device in error will be restarted.

Example:
```
D hh:mm T5Ø17T C1 T2 NEØ      STATUS ERROR-TIMING MODE
   CAW = ØØØØ3E3Ø        CSW = ØCØØ3E38ØEØØØØØØ
    EA = Ø1EØ            OPSW = 42Ø2ØØØØEØØØ3CBA
```

Operator Action: No operator action is required.

9) Timing Mode Time-out

Cause: The program-initiated I/O operation did not receive an interrupt from the proper device within four seconds.

Program Action: The current test assigned to the device in error will be restarted.

Example:
```
D ØØ:Ø3 1T5Ø17T  C1  T3 NEØ      TIMING MODE TIMEOUT
   CAW = ØØØØ3E3Ø        CSW = ØCØØ3E38ØCØØØØØØ
    EA = Ø1EØ            OPSW = 42Ø2ØØØØ9ØØØ3CB4
```

Operator Action: No operator action is required.

10) Device Halted, Interlock

Cause: An attempt was made to access a device which required manual intervention.

Program Action: The program will suspend the device in error and continue.

Example:
```
*A hh:mm 1 T5Ø17T C1  T2 NEØ      DEVICE HALTED ON INTERLOCK
```

Operator Action: Correct interlock condition and resume device.

11) File Protected

Cause: The selected device does not have a write enable ring in the tape reel.

Program Action: The program will suspend the device in error and continue.

Example:
```
*A hh:mm 1 T5Ø17T C1  T2 NEØ      FILE PROTECTED
```

Operator Action: Install write enable ring and resume device.

12) Device Non-Existent

Cause: An attempt was made to access a device which is not part of the subsystem.

Program Action: The program will delete the device in error and continue.

Example:
```
I hh:mm 1 T5Ø17T C1  T2 NE7   DEVICE NON-EXISTENT; DELETED
```

Operator Action: No operator action is required.

13) Printer Error

Cause: An abnormal status condition was detected in the high speed printer during printout of the graph in Test 3.

Program Action: The program will wait for more parameters.

Example: D hh:mm 1 T5Ø17T C1 T2 NEØ PRINTER ERROR

Operator Action: Correct trouble in printer and resume the test program.

14) Device Not Available

Cause: A non-zero condition code was received on a program-initiated Start I/O.

Program Action: The current test assigned to the device in error will be restarted.

Example:
```
D hh:mm 1 T5Ø17T C1 T2 NEØ     DEVICE NOT AVAILABLE
  CAW = ØØØØ3E3Ø       CSW = Ø2ØØ3E8ØØØØØØØØØØ
   EA = Ø1EØ           OPSW = 42Ø2ØØØØ9ØØØ3CB4
```

Operator Action: No operator action is required.

3.9.3.3 Information Messages - The appropriate information message from the list shown below is generated whenever the MAR must inform the operator of some contingent outcome.

1) Enter Parameters

Cause: The program was initially loaded.

Program Action: The program will wait for parameter entry.

Example: *A ØØ:ØØ 1 T5Ø17T ENTER PARAMETERS

Operator Action: Enter the desired parameters.

2) Stopped on Error

Cause: An error condition occurred and either V4 (Stop on Error) was entered or the error was considered by the MAR to be of sufficient magnitude to warrant stopping the program.

Program Action: The program will wait for parameters to resume the test program.

Example: D hh:mm 1 T5Ø17T STOPPED ON ERROR

Operator Action: To continue, enter Resume Action Designator (R®). To restart, enter Begin Action Designator (B®).

3) Program Recycling

Cause: All selected tests and devices have been tested and Cycle on Selected Tests (V14) has been entered.

Program Action: Program will recycle all selected devices and tests.

Example: I hh:mm 1 T5Ø17T PROGRAM RECYCLING

Operator Action: No operator action is required.

4) Device Suspended

Cause: An error occurred that was unrecoverable without manual intervention.

Program Action: The program will suspend the device in error and continue.

Example: D ØØ:ØØ 1 T5Ø17T C1 T3 NEØ DEVICE SUSPENDED BY PROGRAM

Operator Action: Correct source of trouble and resume device. Device will automatically be resumed if the program is told to begin again. A suspended device will not resume when the program recycles under control of Variable 14.

5) Recovery Failed

Cause: Program attempted to recover from an error condition three times and failed.

Program Action: Program will suspend the device in error and continue.

Example:
D hh:mm 1 T5Ø17T C1 T3 NEØ RECOVERY FAILED; 3 ATTEMPTS
D ØØ:Ø2 1 T5Ø17T C1 T3 NEØ DEVICE SUSPENDED BY PROGRAM

Operator Action: If it is desired to resume the device, enter the appropriate parameters.

6) Test Restarted

Cause: An I/O error condition was detected while the program was in Timing Mode.

Program Action: The indicated test will be restarted on the device in error.

Example: I hh:mm 1 T5Ø17T C1 T2 NEØ TEST RESTARTED - TIMING ERROR

Operator Action: No operator action is required.

7) Test Failed

Cause: The device in error was unable to complete the indicated test because of I/O errors while in the Timing Mode. The test is attempted three times before device is suspended.

Program Action: Program will suspend the device in error and continue.

Example:
I hh:mm 1 T5Ø17T C1 T3 NEØ TEST FAILED; 3 ATTEMPTS
D hh:mm 1 T5Ø17T C1 T3 NEØ DEVICE SUSPENDED BY PROGRAM

Operator Action: If it is desired to resume the device, enter the appropriate parameters.

8) Results of Timing Test (Test 2)

I hh:mm 1 T5Ø17T C1 T2 NEØ
FORWARD STOP DISTANCE = ØØ.497 INCHES

I ØØ:Ø2 1 T5Ø17T C1 T2 NEØ
FORWARD START-STOP GAP = ØØ.7Ø1 INCHES

I ØØ:Ø2 1 T5Ø17T C1 T2 NEØ
BACKWARD START TIME = 12.117 MILLISECONDS

I ØØ:Ø2 1 T5Ø17T C1 T2 NEØ
BACKWARD NON-STOP GAP = ØØ:7Ø4 INCHES

```
I ØØ:Ø2 1  T5Ø17T C1 T2 NEØ
FORWARD NON-STOP GAP = ØØ.695 INCHES

I ØØ:Ø2 1 T5Ø17T  C1  T2 NEØ
FORWARD START TIME = 12.751 MILLISECONDS

I ØØ:Ø2 1  T5Ø17T C1  T2 NEØ
FORWARD CREEP DISTANCE = Ø.Ø926 INCH/OVERWRITE
```

9) Header for Graphing Test (Test 3)

```
I ØØ:Ø2 1- T5Ø17T C1  T3 NEØ
READ-STOP CURVES FORWARD=X BACKWARD=O  BOTH=*
```

4.0 SUPPLEMENTARY DATA

4.1 Supplementary Description -

4.1.1 Servicing Information - Timing Tests - The chart below shows the range of allowable figures for the measurements performed by the Timing Test (Test 2) on the UNISERVO XII. Accurate information on the UNISERVO XVI is not available at this time.

UNISERVO XII Timing Chart

MEASUREMENT	7-TRACK Min.	7-TRACK Max.	9-TRACK Min.	9-TRACK Max.
FORWARD STOP DISTANCE - INCHES	.567	.614	.467	.514
FORWARD START-STOP GAP - INCHES	.699	.830	.599	.730
BACKWARD START TIME - MS	12.6	17.2	10.3	14.8
BACKWARD NON-STOP GAP - INCHES	.765	.790	.667	.690
FORWARD NON-STOP GAP - INCHES	.757	.779	.659	.679
FORWARD START TIME	12.6	17.2	10.3	14.8
FORWARD CREEP - INCHES/OVERWRITE	.000	.254	.000	.154

4.1.2 Servicing Information - Read-Stop Curves - The graphs printed by this program can be used as maintenance tools. The Y-axis scale represents the start time measured in milliseconds and the X-axis scale represents the block number. The wave form shown is a representation of tape movement during Start-Stop action between blocks. By making the mechanical adjustments on the brake stud, puck leaf spring, pressure roller, etc., a definite change is produced on the graph. The delay between the detection of the end of the first block and the issuance of the Read Command for the second block can also be noted on the graph. The exact delay time (t_0) can be calculated by using the formula:

$$t_0 = 3.2 \times .1044n \text{ (milliseconds)}$$

Where n = the block number of the initial block.

Each plotted point on the graph is a measurement of time from the issuance of Read Commands, until the first frame of the next block is seen in memory. The data is written on the tape in non-stop mode to give a common reference but the read-back, when the actual count is taken, is done in start-stop mode. The mechanism's reaction time is obtained by always allowing the brake action to initiate for a certain period of time after reading of a block. This period of time increases for successive blocks. The first block has the start issued immediately after brake initiation begins, thereby not allowing the mechanism to slow down. As the delay between the brake initiation and start signal increases, the brake has longer to attempt to engage. This action is shown on the graph as a sharply sloping line (Figure 1, Note A). This should continue for 20 plotted points. Because of the increasing delays in the program, true start-stop should occur very close to the

20th block. The indication on the graph that this has occurred is a sharp jump-up (Figure 1, Note B). This should be a clean jump where non-stop mode is left, and start-stop is obtained.

The next characteristic-of the curve is a dip (Figure 1, Note C). This represents a resonant frequency of the leaf spring which has the puck attached. It is obtained here as the delay after brake initiation increases. The lowest limit of the dip will occur approximately at the 35th block. The hump following the dip in the graph is the anti-resonant frequency of the leaf spring (Figure 1, Note D), again due to the increasing delay in the program. The peak of this hump will occur approximately at the 55th block.

The final significant point on the graph occurs approximately at the 88th block. (Figure 1, Note E). Here the delay between the stop and start signal has increased to the point of complete start-stop mode. The delay is so great that all interaction is eliminated.

All of the above characteristics hold true for both forward and backward curves. It should be noted that the compatability of the forward and backward tape motion is indicated by the similarity of the two curves; ideally they should overlay each other. The curve characteristics hold for both 7-Track and 9-Track devices, but the difference in interblock gap size (see Figure 3) will cause the whole graph for the 7-Track servo to be higher on the Y-axis than the 9-Track graph.

The adjustments associated with the start-stop time affect the graph in a known manner (see Figure 2). The movement of the brake stud closer to the puck moves the graph toward the left on the "A" adjustment axis. Moving the brake stud away from the puck moves the graph in the opposite direction. The adjustment made to the "leaf spring pre-load screw" affects the position of the graph vertically as shown at Figure 2 "B" adjustment axis. Both these adjustments are very critical. The slightest amount of change makes a big difference in the position of the graph. Therefore, extreme care should be taken when these adjustments are being made. It should also be noted that the adjustment reactions are not exactly vertical or horizontal. This is because the adjustments are interacting. On Figure 2, the adjustment shown as "Adjustment C" is the indication the graph gives when the pressure roller is allowing tape to slip. Note though, that the jump for start-stop mode still occurs very close to Block 20. Even if it occurs much sooner than Block 20 it still indicates that the brake stud is too close to the puck.

The actual tolerances set up in previous adjustment procedures still hold true in adjusting the tape drive. The only difference is the presentation of a graph on a printer instead of an oscilloscope. The criteria for a proper presentation of tape motion is shown in Figure 3. The significant points to adjust to are: point (1) should occur as close to the 20th block as possible, and point (2) should occur between the limits shown. In this case only the portion of the curve which is leveled out should be adjusted to lie in the center of this nominal range. If the two previous adjustments are made to this tolerance, points A and B will automatically fall into place. Again it is important to note that forward and backward graphs should overlay each other. Any points that do not lie close to the general curve of the graph indicate an inconsistency in mechanical action. If these two adjustments do not bring the graph to proper positioning, the usual procedure for regapping the coil can be followed. A new attempt for fine adjustment should then be made.

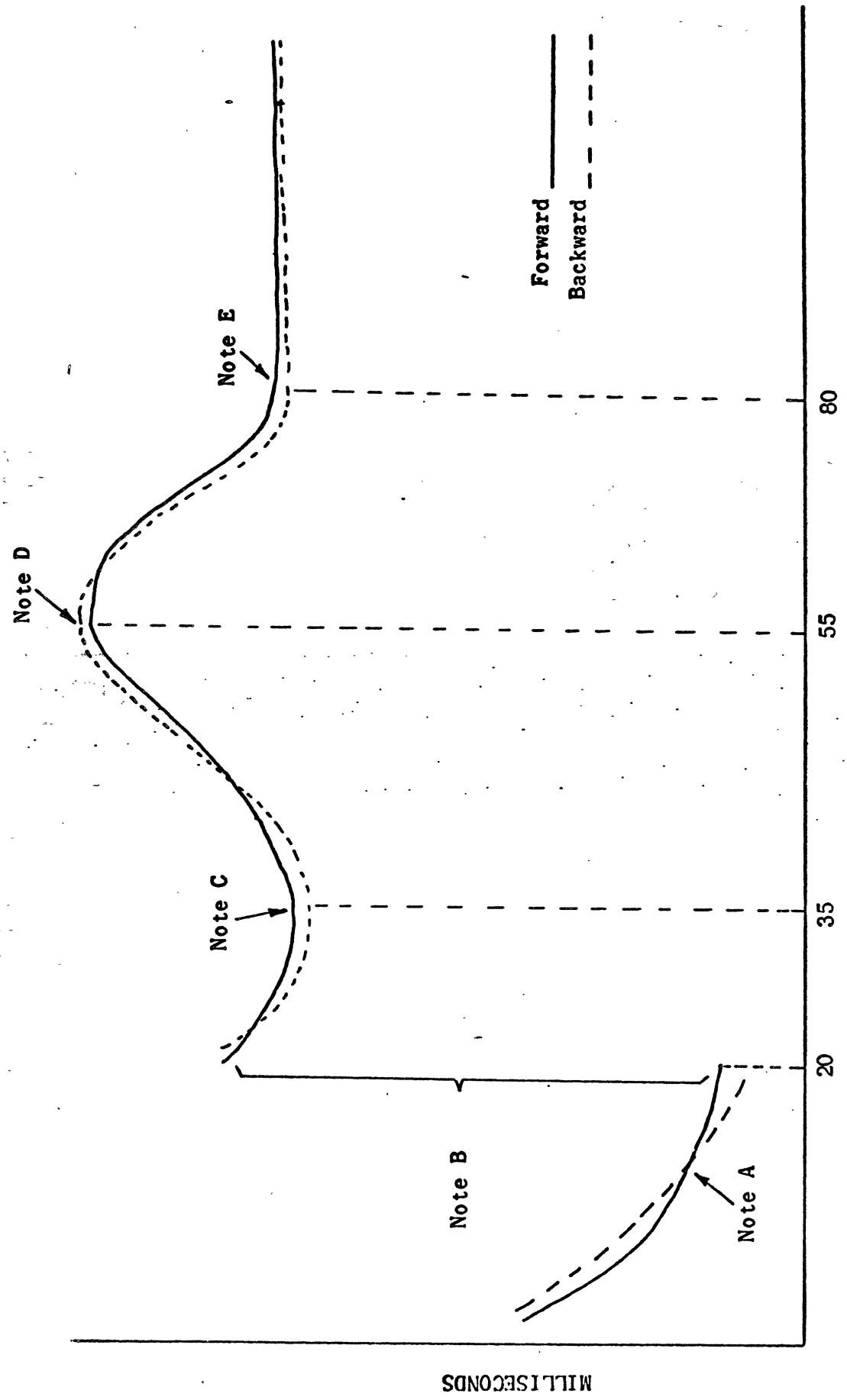


Figure 1. Generalized Read-Stop Curves.

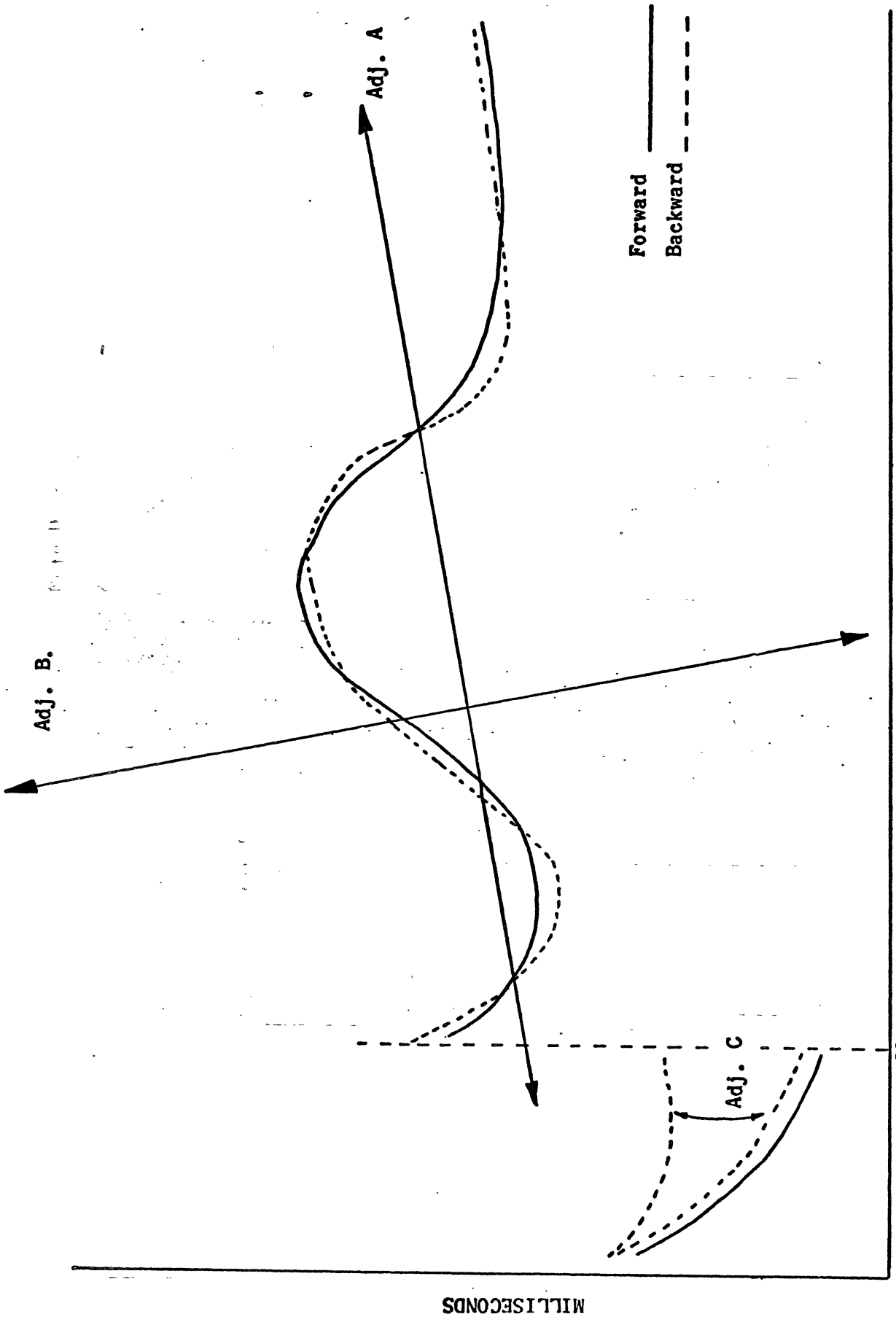


Figure 2. Adjustment Characteristics of Read-Stop Curves

4.2.3 Read-Stop Curve Parameters -

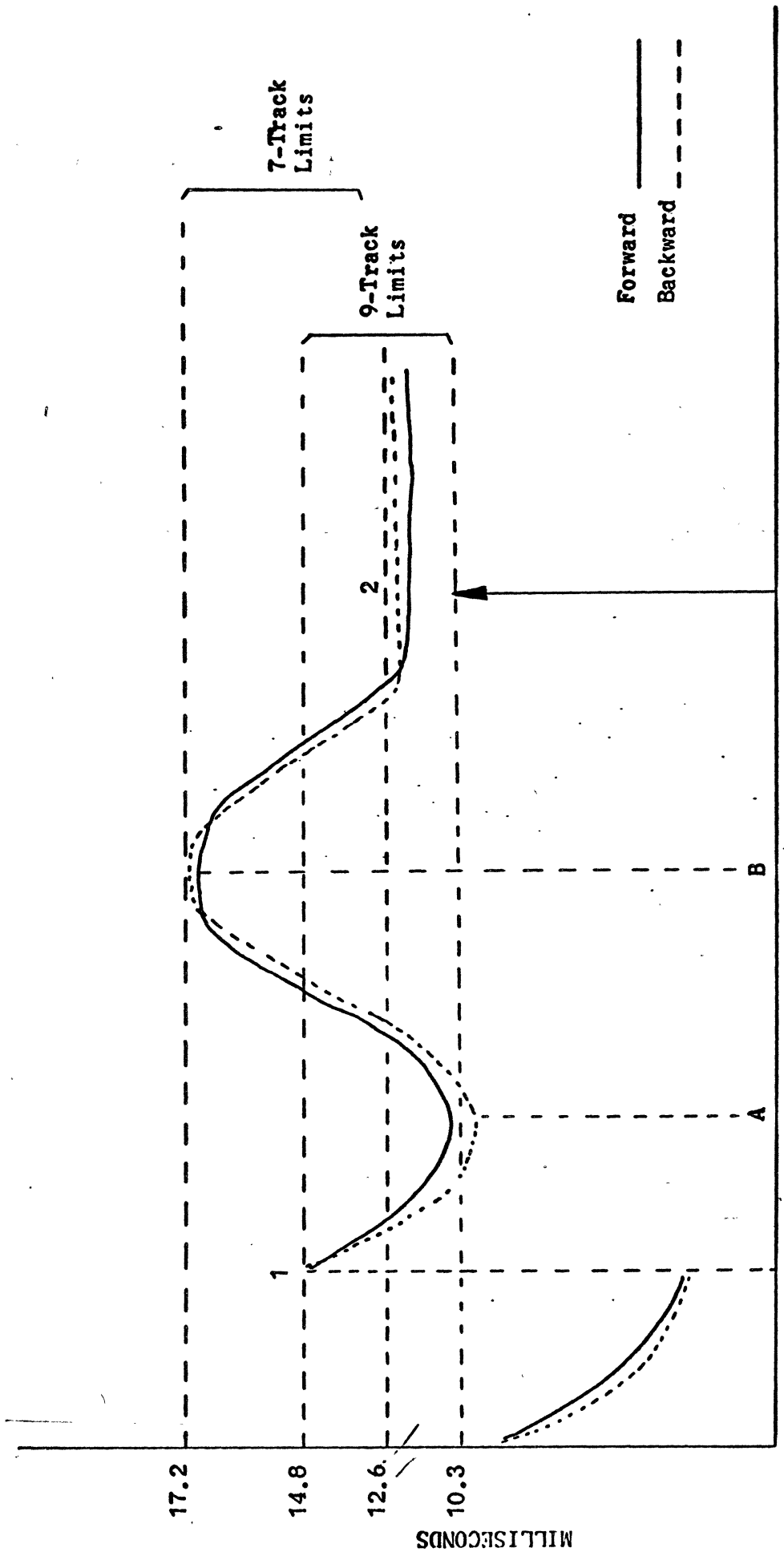
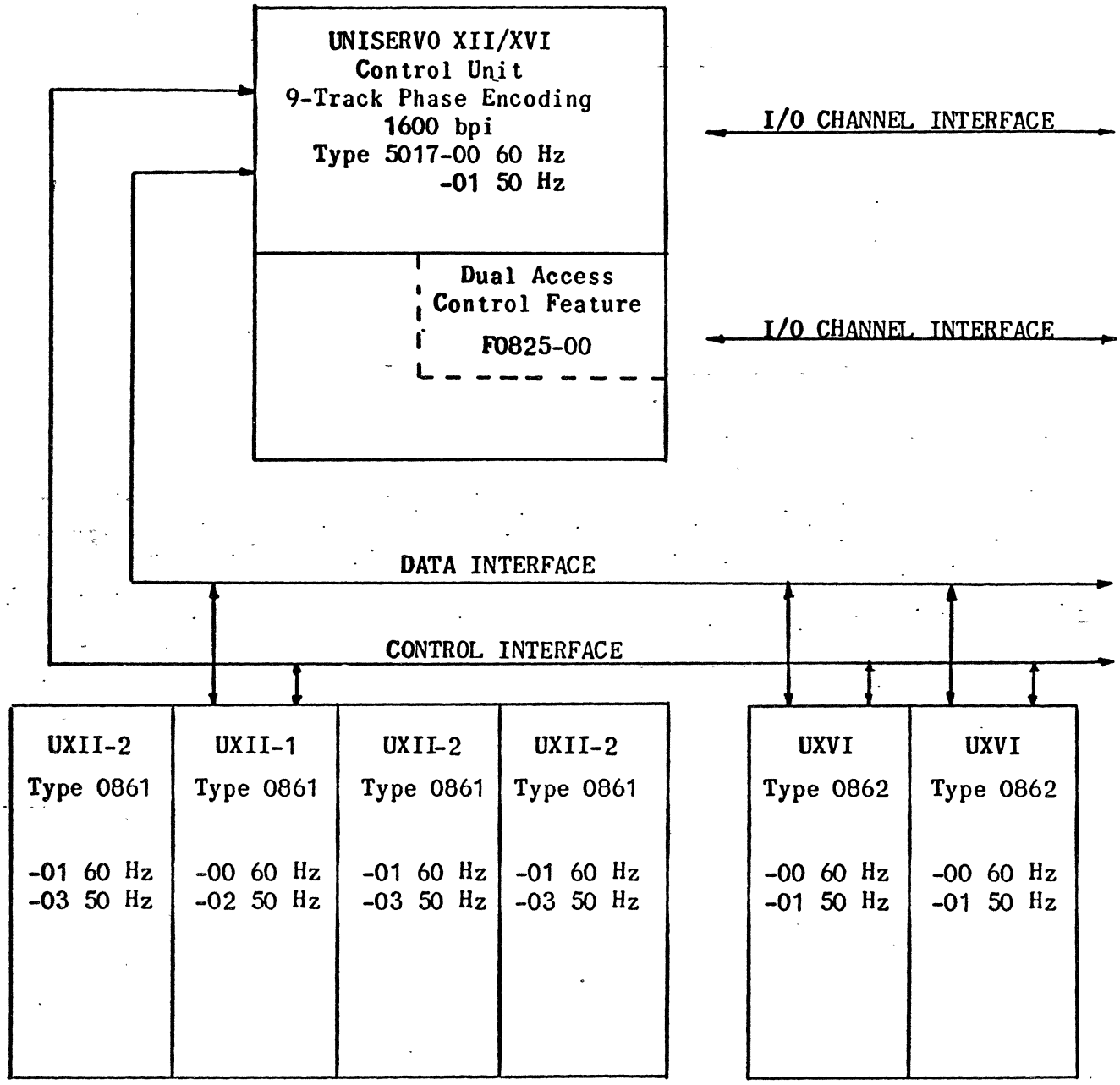
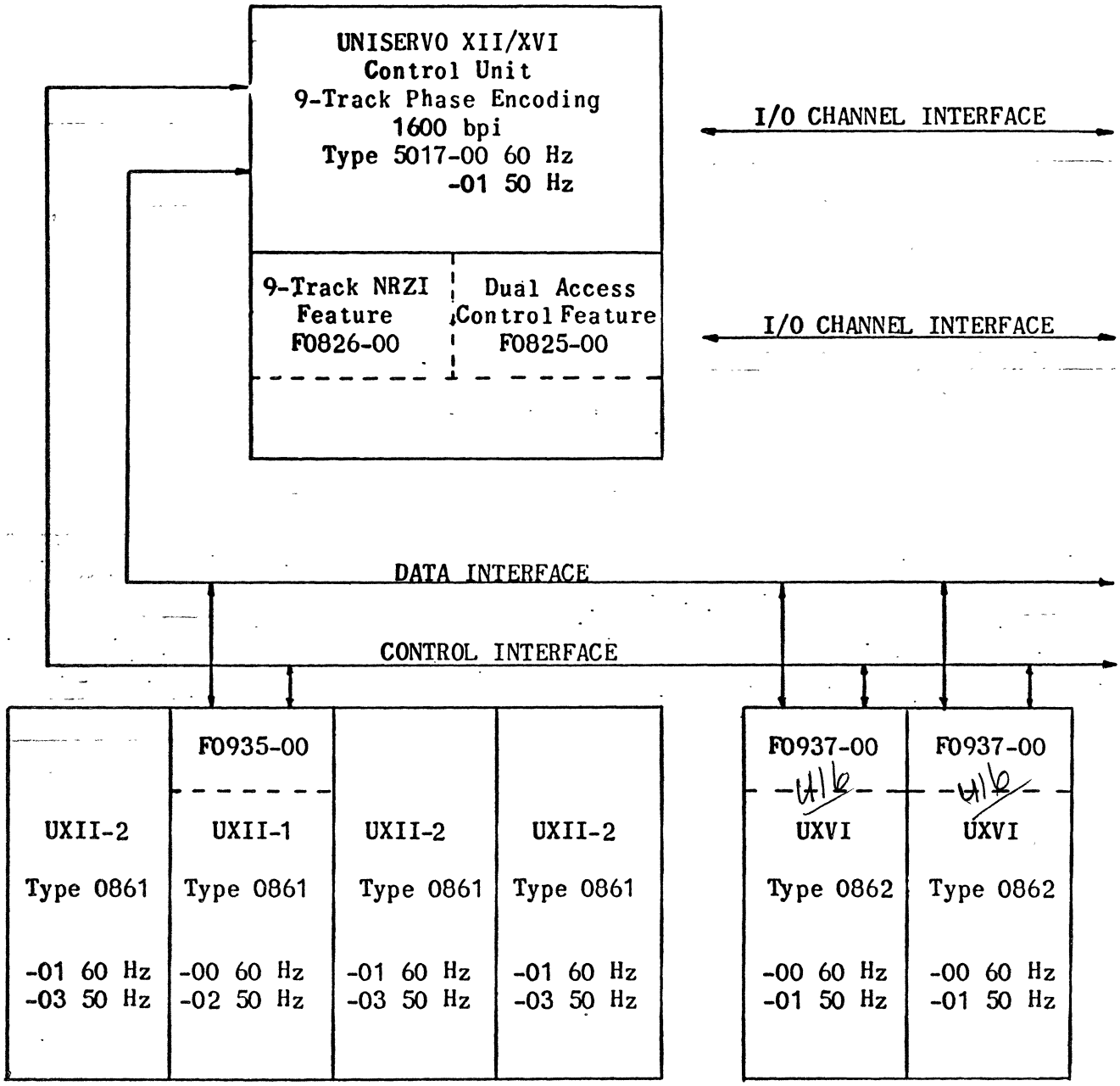


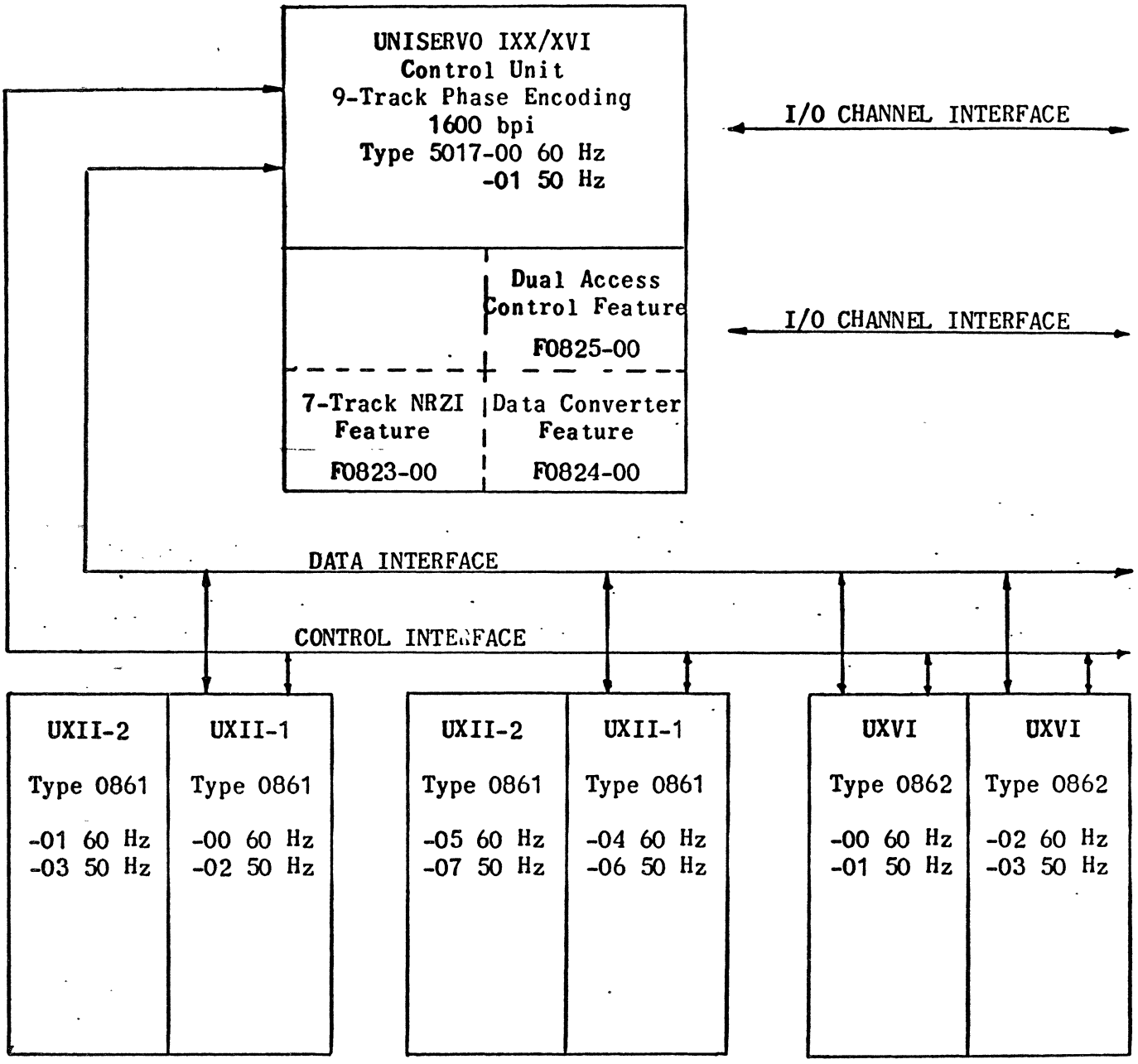
Figure 3. Read-Stop Curve Parameters.

4.2.4 Configurations (Non-Simultaneous Operation) -

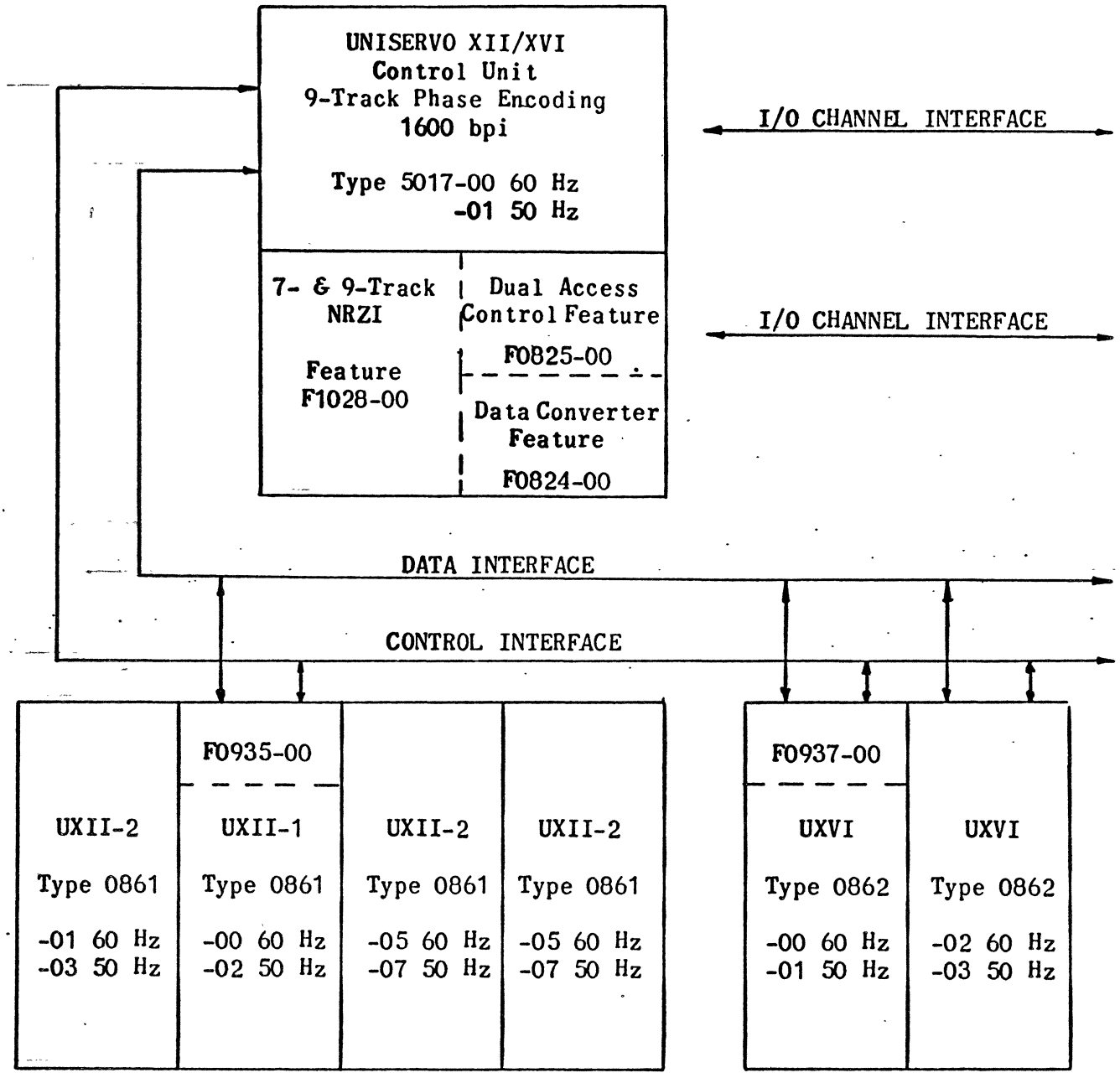


4.2.4 Configurations (Non-Simultaneous Operation) - (Continued)

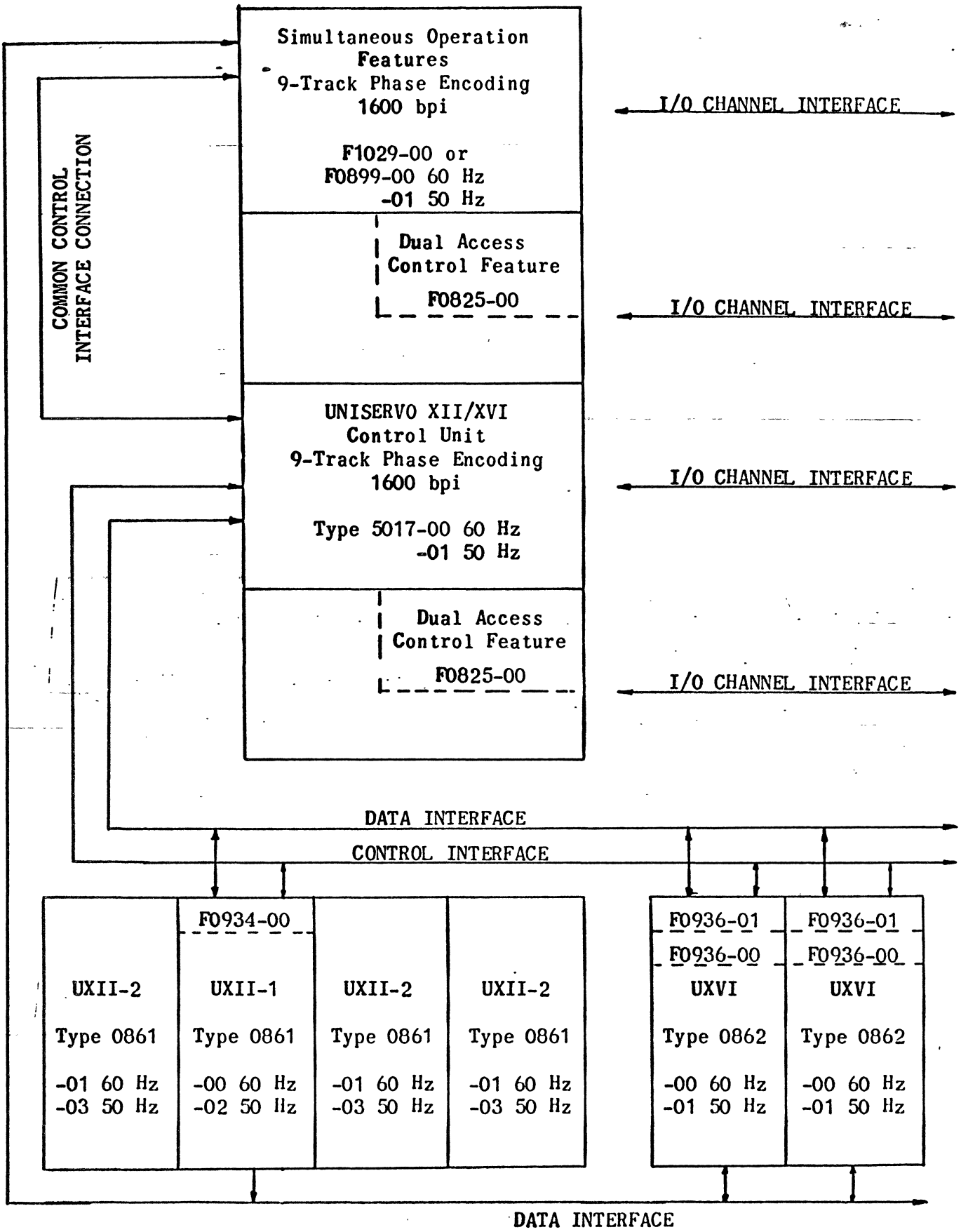


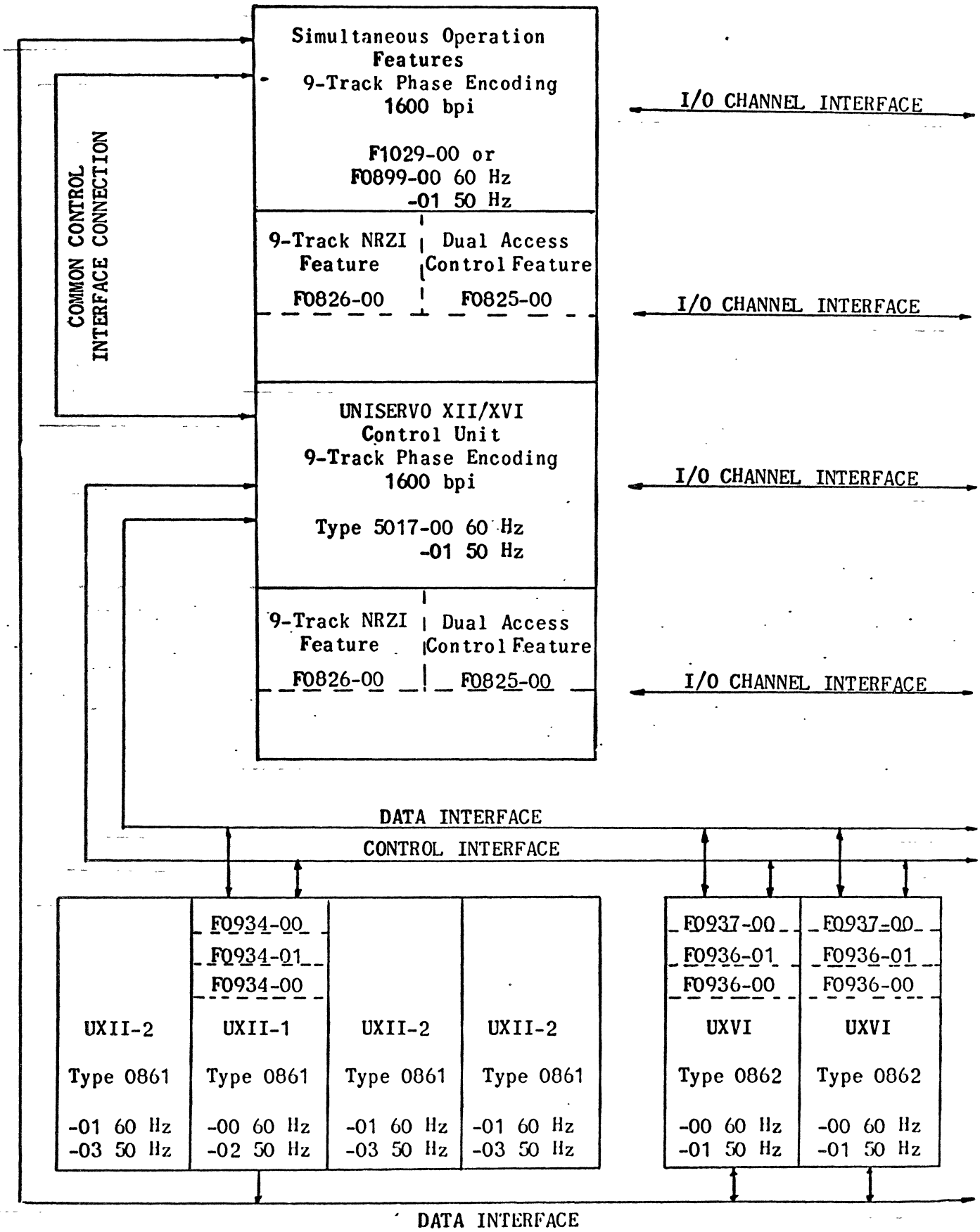

UNISERVO IXX/XVI
Control Unit
9-Track Phase Encoding
1600 bpi
Type 5017-00 60 Hz
-01 50 Hz
I/O CHANNEL INTERFACE
Dual Access
Control Feature
F0825-00
I/O CHANNEL INTERFACE
7-Track NRZI
Feature
F0823-00
Data Converter
Feature
F0824-00
DATA INTERFACE
CONTROL INTERFACE
UXII-2
Type 0861
-01 60 Hz
-03 50 Hz
UXII-1
Type 0861
-00 60 Hz
-02 50 Hz
UXII-2
Type 0861
-05 60 Hz
-07 50 Hz
UXII-1
Type 0861
-04 60 Hz
-06 50 Hz
UXVI
Type 0862
-00 60 Hz
-01 50 Hz
UXVI
Type 0862
-02 60 Hz
-03 50 Hz

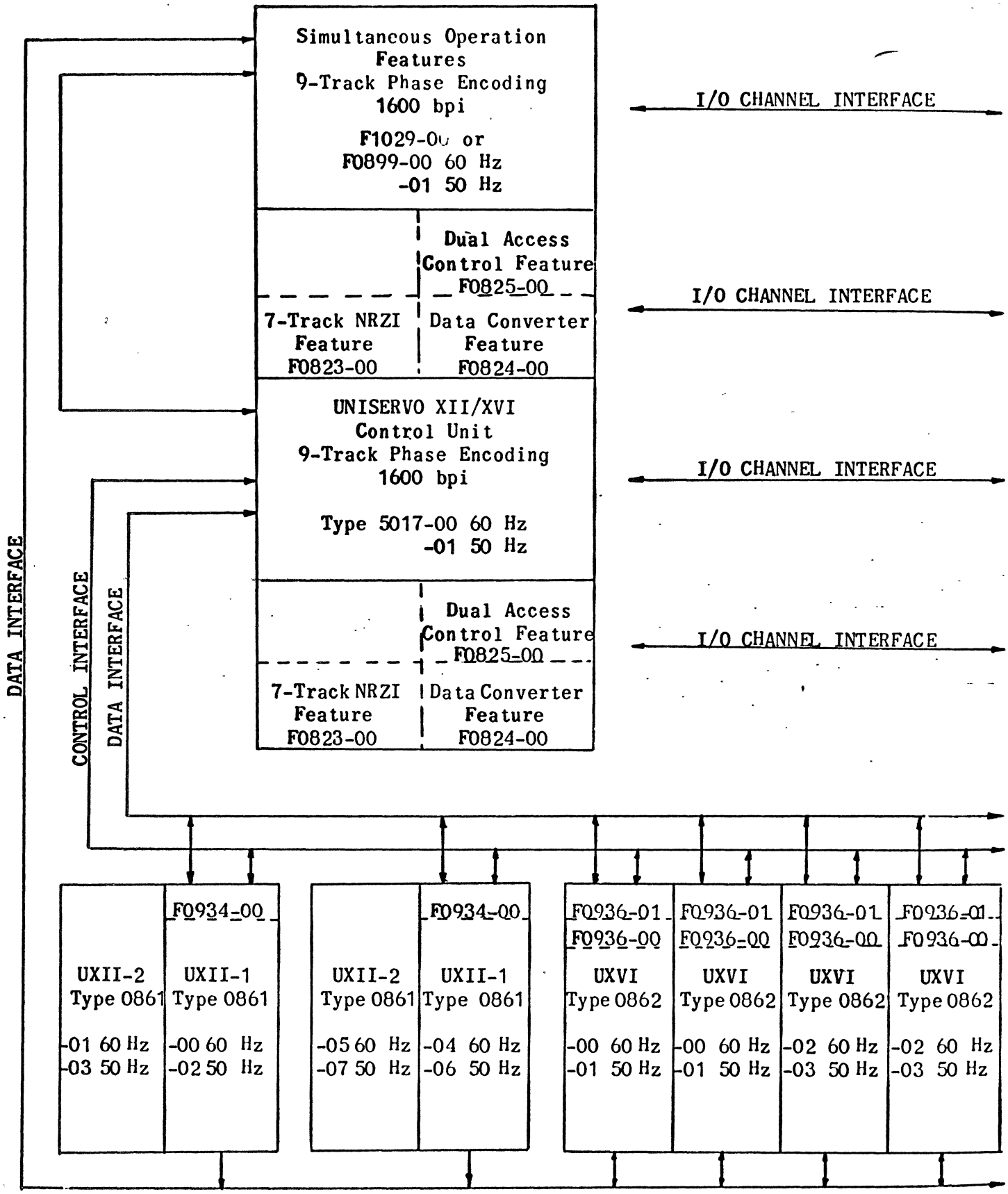
4.2.4 Configurations (Non-Simultaneous Operation) - (Continued)

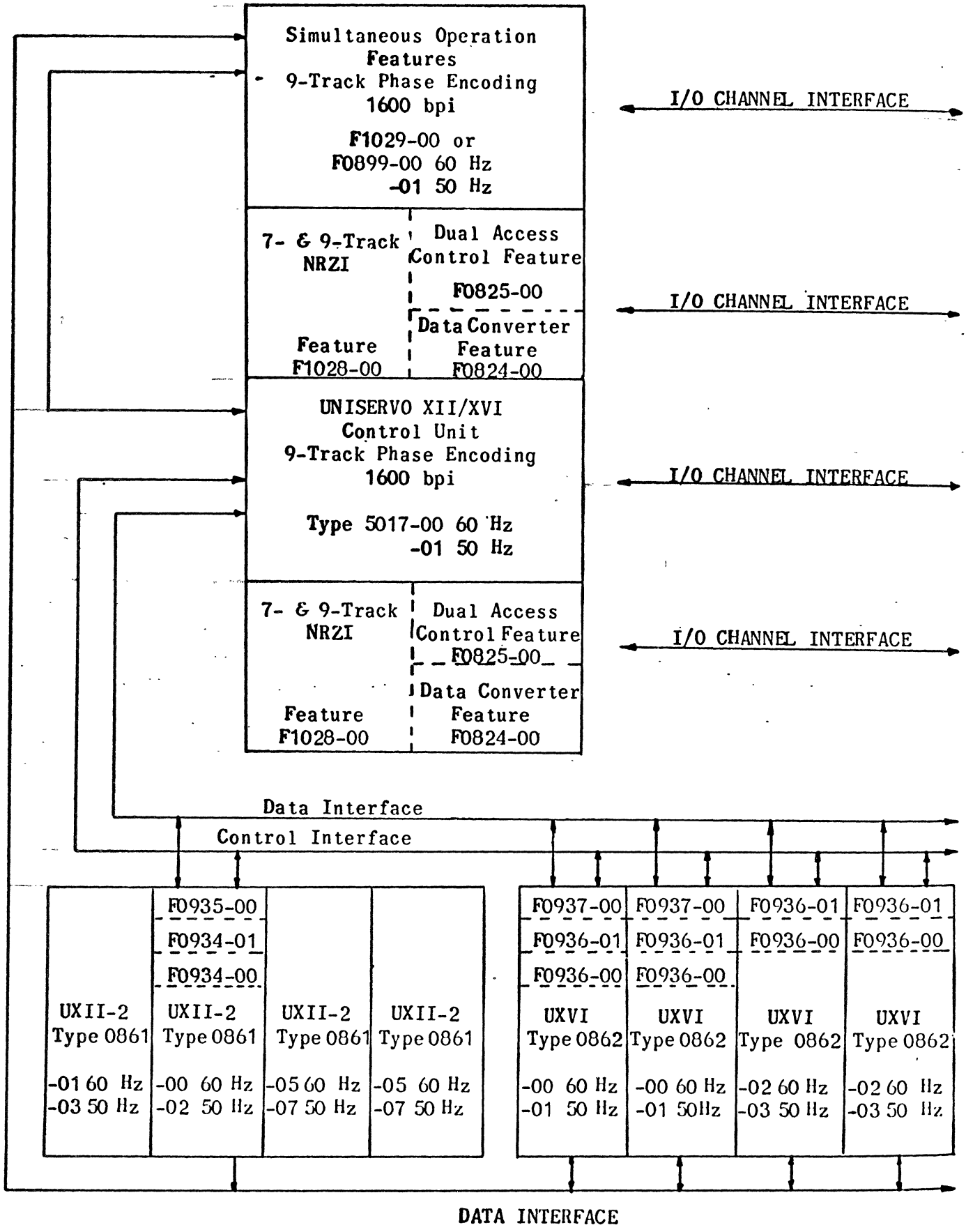


4.2.5 Configurations (Simultaneous Operation)




Simultaneous Operation Features
9-Track Phase Encoding
1600 bpi
F1029-00 or
F0899-00 60 Hz
-01 50 Hz
I/O CHANNEL INTERFACE
COMMON CONTROL INTERFACE CONNECTION
9-Track NRZI Feature
F0826-00
Dual Access Control Feature
F0825-00
I/O CHANNEL INTERFACE
UNISERVO XII/XVI Control Unit
9-Track Phase Encoding
1600 bpi
Type 5017-00 60 Hz
-01 50 Hz
I/O CHANNEL INTERFACE
9-Track NRZI Feature
F0826-00
Dual Access Control Feature
F0825-00
I/O CHANNEL INTERFACE
DATA INTERFACE
CONTROL INTERFACE
F0934-00
F0934-01
F0934-00
UXII-2
Type 0861
-01 60 Hz
-03 50 Hz
UXII-1
Type 0861
-00 60 Hz
-02 50 Hz
UXII-2
Type 0861
-01 60 Hz
-03 50 Hz
UXII-2
Type 0861
-01 60 Hz
-03 50 Hz
F0937-00
F0936-01
F0936-00
UXVI
Type 0862
-00 60 Hz
-01 50 Hz
F0937-00
F0936-01
F0936-00
UXVI
Type 0862
-00 60 Hz
-01 50 Hz
DATA INTERFACE


Simultaneous Operation Features
9-Track Phase Encoding
1600 bpi
F1029-00 or
F0899-00 60 Hz
-01 50 Hz
I/O CHANNEL INTERFACE
Dual Access Control Feature F0825-00
7-Track NRZI Feature F0823-00
Data Converter Feature F0824-00
I/O CHANNEL INTERFACE
UNISERVO XII/XVI Control Unit
9-Track Phase Encoding
1600 bpi
Type 5017-00 60 Hz
-01 50 Hz
I/O CHANNEL INTERFACE
Dual Access Control Feature F0825-00
7-Track NRZI Feature F0823-00
Data Converter Feature F0824-00
I/O CHANNEL INTERFACE
DATA INTERFACE
CONTROL INTERFACE
DATA INTERFACE
F0934-00
UXII-2 Type 0861
-01 60 Hz
-03 50 Hz
F0934-00
UXII-1 Type 0861
-00 60 Hz
-02 50 Hz
F0934-00
UXII-2 Type 0861
-05 60 Hz
-07 50 Hz
F0934-00
UXII-1 Type 0861
-04 60 Hz
-06 50 Hz
F0936-01 F0936-00
UXVI Type 0862
-00 60 Hz
-01 50 Hz
F0936-01 F0936-00
UXVI Type 0862
-00 60 Hz
-01 50 Hz
F0936-01 F0936-00
UXVI Type 0862
-02 60 Hz
-03 50 Hz
F0936-01 F0936-00
UXVI Type 0862
-02 60 Hz
-03 50 Hz


Simultaneous Operation Features
9-Track Phase Encoding
1600 bpi
F1029-00 or
F0899-00 60 Hz
-01 50 Hz
I/O CHANNEL INTERFACE
7- & 9-Track NRZI
Feature F1028-00
Dual Access Control Feature F0825-00
Data Converter Feature F0824-00
I/O CHANNEL INTERFACE
UNISERVO XII/XVI Control Unit
9-Track Phase Encoding
1600 bpi
Type 5017-00 60 Hz
-01 50 Hz
I/O CHANNEL INTERFACE
7- & 9-Track NRZI
Feature F1028-00
Dual Access Control Feature F0825-00
Data Converter Feature F0824-00
I/O CHANNEL INTERFACE
Data Interface
Control Interface
UXII-2 Type 0861 -01 60 Hz -03 50 Hz
F0935-00
F0934-01
F0934-00
UXII-2 Type 0861 -00 60 Hz -02 50 Hz
UXII-2 Type 0861 -05 60 Hz -07 50 Hz
UXII-2 Type 0861 -05 60 Hz -07 50 Hz
F0937-00
F0936-01
F0936-00
UXVI Type 0862 -00 60 Hz -01 50 Hz
F0937-00
F0936-01
F0936-00
UXVI Type 0862 -00 60 Hz -01 50Hz
F0936-01
F0936-00
UXVI Type 0862 -02 60 Hz -03 50 Hz
F0936-01
F0936-00
UXVI Type 0862 -02 60 Hz -03 50 Hz
DATA INTERFACE

COMMAND CODE FORMATS

The Control Unit will respond to the following commands:

COMMAND	0	1	2	3	4	5	6	7
Test	X	X	(0 1	0 1)	0	0	0	0
Set Inhibit Status	X	X	0	1	0	0	0	0
Reset Inhibit Status	X	X	1	0	0	0	0	0
Sense	0	0	0	0	0	1	0	0
Sense/Reserve	1	1	1	1	0	1	0	0
~~Sense~~/Release	1	1	0	1	0	1	0	0
Write	0	0	0	0	0	0	0	1
Read	0	0	0	I	0	0	1	0
Read Backward	0	0	0	I	1	1	0	0
Control	0	0	1 C	0 C	1 C	1	1	1
Mode Set	D	D	M	M	M	0	1	1

X, I = 1 or 0 bit

CCC (Control Code)

000 = Rewind
001 = Rewind with interlock
010 = Erase
011 = Write tape mark
100 = Backspace block
101 = Backspace file
110 = Forward space block
111 = Forward space file

4.2.6 Function Codes - (Continued)

DD (Density Set)

00 = 200 bpi
01 = 556 bpi
10 = 800 bpi
11 = Set 9-Track Mode

} 7-Track NRZI Operation

MMM (Mode Modifiers; DD = 11 only)

000 = 1600 bpi Phase Encoding (Reset Condition)
001 = 800 bpi NRZI

NOTE: 9-Track Operation overrides but does not reset a 7-Track Mode setting. 7-Track operation overrides but does not reset a 9-Track Mode setting. 9-Track Operation Mode settings apply only to WRITE, WRITE TAPE MARK, or ERASE Commands executed from load point.

4.2.6 Function Codes - (Continued)

MMM (Mode Modifiers DD ≠ 11)	Set Density	Set Odd Parity	Set Even Parity	Data Converter On	Data Converter Off	Translator On	Translator Off	Request TIE (Track in Error)	Low Gain	
000										NOP (No Operation)
001										Failure-Finding Mode Only
010	x	x		x			x			Reset Condition (Only if Data Converter installed)
011 (DD = 00)								x		9-Track only
011 (DD = 01)									x	*
100	x		x		x		x			
101	x		x		x	x				
110	x	x			x		x			Reset Condition (If Data Converter not installed)
111	x	x			x	x				

*The low gain condition will apply to the "READ" or "SPACE" operation immediately following the MODE SET Command. At the end of the operation, the mode is reset to normal.

X = Condition set or activated by related mode modifier bit configurations.

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4.2.7 Status/Sense/Bytes -

Status Byte

The Status Byte provides the overall information about status and conditions detected in the operation completed. The Control Unit initiates the sequences to present status to the channel at the end of the Initial Selection Sequence, at the completion of unit selection of a CONTROL operation, and at the completion of the operation. The status bits are reset to binary zero when the status presented is accepted by the channel. The following defines the significance of binary one in each status bit.

Bit Designation	Interpretation
0 ATTENTION	The selected tape unit is busy, i.e., ready and rewinding or ready and under control of the other Control Unit. End status will not be presented with this status bit.
1 STATUS MODIFIER	Present with the BUSY bit (bit 3) to indicate Control Unit busy. On a Control Unit with two I/O Channel Interfaces, Control Unit busy is indicated to one Interface if an Initial Selection Sequence is attempted while the Control Unit is presently operating with, or reserved by, the alternate I/O Interface.
2 CONTROL UNIT END	a. When the Control Unit completes a CONTROL operation that kept it busy independently of the channel, during which time it was either addressed (causing a Control Unit busy indication) or an unusual condition was detected (UNIT CHECK or UNIT EXCEPTION), CONTROL UNIT END will be presented with DEVICE END. The Control Unit is considered busy independently of the Channel during the interval between the acceptance of the CHANNEL END status byte and the DEVICE END status byte by the channel. b. Whenever a Control Unit busy sequence occurs on one I/O Interface of a Dual Access Control Unit, and the Control Unit is presently operating with, or reserved by, the alternate I/O Interface, a CONTROL UNIT END Status byte will be presented to the I/O Interface that received the Control Unit busy indication when the Control Unit completes the operation in progress, or is released by, the alternate I/O Interface.

3 BUSY	a. Present with STATUS MODIFIER to indicate Control Unit busy. b. Present with status already stored if status pending for addressed tape unit, when the command is other than a TEST, SET INHIBIT STATUS OR RESET INHIBIT STATUS.
4 CHANNEL END	For SENSE, REQUEST TIE, WRITE, READ AND READ BACKWARD commands, CHANNEL END is presented with DEVICE END when the operation is completed at the Control Unit level. It is presented on CONTROL commands, after the tape unit is tested and available. If early errors prevent tape motion, and the operation is aborted early, the CHANNEL END status bit is not sent to the channel. It is also presented at the end of initial selection with DEVICE END on MODE SET commands (except REQUEST TIE).
5 DEVICE END	Indicates that the operation is complete at the Control Unit level. When errors are detected before tape motion is initiated, DEVICE END is not presented with error status. Operations that are aborted when in progress (e.g. Due to Equipment Check) will cause DEVICE END to be sent with UNIT CHECK and CHANNEL END.
6 UNIT CHECK	Indicates: a. A bit in Sense Byte 0 has been set as a result of the current operation (If the error condition is detected before tape motion is initiated, UNIT CHECK will be presented without end status). b. A READ BACKWARD, BACKSPACE BLOCK, or BACKSPACE FILE is attempted on a tape unit when the tape is positioned at load point (No end status is presented in this case). c. A REWIND WITH INTERLOCK has been completed at the Control Unit level, i.e. when the tape unit becomes non-ready. If the operation is initiated, DEVICE END will be presented with UNIT CHECK and CONTROL UNIT END.
7 UNIT EXCEPTION	Indicates: a. A WRITE, WRITE TAPE MARK or ERASE operation is performed in the end-of-tape area.

b. A tape mark is sensed during a READ, READ BACKWARD, FORWARD SPACE BLOCK, or BACK-SPACE BLOCK operation.

In cases a. and b. UNIT EXCEPTION is presented with DEVICE END (and CONTROL UNIT END on CONTROL operations).

Sense Data Bytes

The sense data provides detailed information about the unusual conditions detected in the last operation and the current status of the selected tape unit. Sense bits that set as a result of error or fault conditions during an operation will remain set until cleared upon initiation of a new command. Executing a SENSE command will not change the state of these bits (all those not marked with an asterisk). Bits that are marked with an asterisk (*) will reflect the current state of the selected tape unit. For example, if a "non-ready" condition is detected and the operation is aborted early, Tape Unit Status B and Intervention Required will set in sense bytes 1 and 0 respectively. If, between the time that the operation was aborted and the SENSE command executed, the tape unit became "ready", then the sense data returned to the channel will be Intervention Required and Tape Unit Status A.

No additional sense information can be set as a result of executing a SENSE command once the command has been accepted (i.e. odd command byte parity and valid command code). The following tables describe the significance of the sense bytes.

SENSE BYTE 0 . MODE OF OPERATION

BIT	DESIGNATION	PHASE-ENCODING	NRZI
0	Command Reject	a. Set when a WRITE, WRITE TAPE MARK, or ERASE Command was attempted on a file-protected tape unit. b. Set when an invalid command is transmitted to the Control Unit (see Table - Section 2.4.). This condition will not be set if a BUS OUT Check occurred on a command transfer. c. The Tape Unit Incompatibility bit was set(Bit 7, Sense Byte 1).	Same
1	Intervention Required	Set whenever Tape Unit Status A is inactive, i.e., a non-existent or non-ready tape unit was selected on other than a SENSE Command. (Bit 1 is not set in Sense Byte 1.)	Same
2	BUS OUT Check	Set whenever even parity appears on the BUS OUT for data or command transfers. During WRITE operations, if this condition is set on a data transfer, the operation is terminated, and the error byte is not written on the tape. If the error occurs on the first data transfer Word Count Zero will be set in conjunction with BUS OUT Check.	Same NOTE: If this condition is detected during the data transfer on a REQUEST TIE Command, the operation terminates but the information received is ignored. Any TIE information already stored is not disturbed.
3	Equipment Check	Set whenever an Equipment Check occurs, i.e., Bits 0, 1, or 5 of Sense Byte 4 have been set.	Same

BIT	DESIGNATION	PHASE-ENCODING	NRZI
4	Data Check	Set whenever a Data Check occurs, i.e., Bit 0 of Sense Byte 1, or Bits 0, 1, 2, 3, 4 of Sense Byte 3 have been set.	Same
5	Overrun	Set if service is requested on the I/O Interface but data cannot be transferred due to a late "SERVICE OUT" signal from the channel. If this occurs on the first data transfer of a WRITE operation, Word Count Zero will be set in conjunction with Overrun. (Not set on REQUEST TIE or SENSE Commands.)	Same
6	Word Count Zero	a. Set during a WRITE operation if transfer of data is prevented when the first byte of data is requested. This can be due to a "COMMAND OUT" response to the data byte request, even parity detected for the data byte transfer (see BUS OUT Check), or a channel overload (see Overrun). No new tape motion will occur if any of these conditions are detected. If non-stop operation is indicated, the previous operation will terminate properly. b. Set if the end-of-block is detected on READ or READ BACKWARD operations before any data bytes are recognized (missed Start Sentinel).	Same
7	Data Converter Check	Not applicable - always set to zero.	

SENSE BYTE 1		MODE OF OPERATION	
BIT	DESIGNATION	PHASE-ENCODING	NRZI
0	Noise	When Reading or Read Checking data from Phase Encoded tapes, the checks performed to set the Noise bit are essentially the same as in NRZI recording. However, two basic differences pertaining to the quality of the check exist. First, when checking for tape hash, the outputs of the block detector circuits for each track are monitored. Since these circuits tend to reject noise, a single "bit pick-up" would not activate the block detector outputs and the Noise bit would not set. In NRZI recording, the Noise bit would set, since the data lines are monitored directly. Second, when checking for gaps in the data, or data "drop-outs", all block detector outputs must be deactivated together, before the Noise bit sets. In Phase-Encoded recording, a signal results from writing either a "1" bit or a "0" bit. Therefore, within the block, a signal is normally present in all tracks. Thus only a relatively serious condition could cause the Noise bit to set (e.g., a lateral crease in the tape). In NRZI recording, however, a signal is present only when "1" bits are written. Therefore, a small defect in one track, when recording 1-bits only in that track, will cause the Noise bit to set. The Noise bit, then, should set relatively infrequently, as compared to the NRZI mode of operation.	a. Tape Hash results when data (or noise due to tape defects) is detected on Read Check sooner than was expected during WRITE or WRITE TAPE MARK operations. During ERASE operations, data (or noise due to tape defects) was detected on Read Check while the tape was being erased. b. During WRITE or WRITE TAPE MARK operations, while while Read Checking the recorded data, a gap in the data was detected which was not long enough to set the end-of-block condition. This can occur due to unrecordable areas on the tape. c. During READ, READ BACKWARD, FORWARD SPACE BLOCK, and BACKSPACE BLOCK operations a data "drop-out" occurred on Read which was not long enough for the end-of-block condition to be detected.

<table>
<tr><th>BIT</th><th>DESIGNATION</th><th>PHASE-ENCODING</th><th>NRZI</th></tr>
<tr><td>1*</td><td>Tape Unit Status A</td><td>Selected and Ready</td><td>Same</td></tr>
<tr><td>2*</td><td>Tape Unit Status B</td><td>Not ready, rewinding, or under control of the other Control Unit.
<table>
<tr><th>Status A</th><th>Status B</th><th>Tape Unit Status</th><th>Bit Set in Status Byte</th></tr>
<tr><td>0</td><td>0</td><td>Non-existent</td><td>UNIT CHECK</td></tr>
<tr><td>0</td><td>1</td><td>Not ready</td><td>UNIT CHECK</td></tr>
<tr><td>1</td><td>0</td><td>Ready and not busy</td><td>---</td></tr>
<tr><td>1</td><td>1</td><td>Ready and busy, i.e., rewinding or under control of other Control Unit</td><td>ATTENTION</td></tr>
</table></td><td>Same</td></tr>
<tr><td>3*</td><td>7-Track</td><td>Same</td><td>The selected unit has a 7-Track head installed.</td></tr>
<tr><td>4*</td><td>Load Point</td><td>The tape on the selected unit is positioned at load point.</td><td>Same</td></tr>
<tr><td>5*</td><td>End of Tape</td><td>The tape on the selected unit is in the end-of-tape area.</td><td>Same</td></tr>
<tr><td>6</td><td>File Protect</td><td>The tape on the selected unit does not have a write enable ring.</td><td>Same</td></tr>
<tr><td>7</td><td>Tape Unit Incompatibility</td><td>a. Tape Unit is selected on any command requiring tape motion and any of the following contitions occur:
Addressed tape unit is a UVI-C or UVIII-C, 7- or 9-Track, and is indicating the phase encoding mode of operation.</td><td>Same</td></tr>
</table>

BIT	DESIGNATION	PHASE-ENCODING	NRZI
7	Tape Unit Incompatibility	Addressed tape unit is a UXII or UXVI, 7-Track, and is indicating the phase-encoding mode of operation. Addressed tape unit is a UXII or UXVI, 9-Track, and failed to reset to 1600 bpi mode. (Load point only.) b. Tape unit is selected for a "write-type" operation from load point and the following occurs: Addressed tape unit is UVI-C or UVIII-C, 9-Track type.	
		c. Tape unit is selected for a "read-type" operation from load point and any of the following conditions occur: Addressed tape unit is a UVI-C or UVIII-C, 9-Track, and the tape is written in 1600 bpi phase-encoding mode. Addressed tape unit is a UXII or UXVI, 9-Track, and failed to set to 800 bpi mode when the tape is written in 800 bpi NRZI mode.	Same
		d. A "write-type" operation was attempted on a UNISERVO XII, VI-C, or VIII-C on the second Control Unit (CUB). NOTE: In cases a, b, and d above, no tape motion occurs as a result of the attempted operation. In case c above, the condition is detected after the first "read-type" operation has been initiated. If the READ-TYPE Command is to be attempted a second time, a REWIND Command should first be executed in order to reposition the tape.	Same

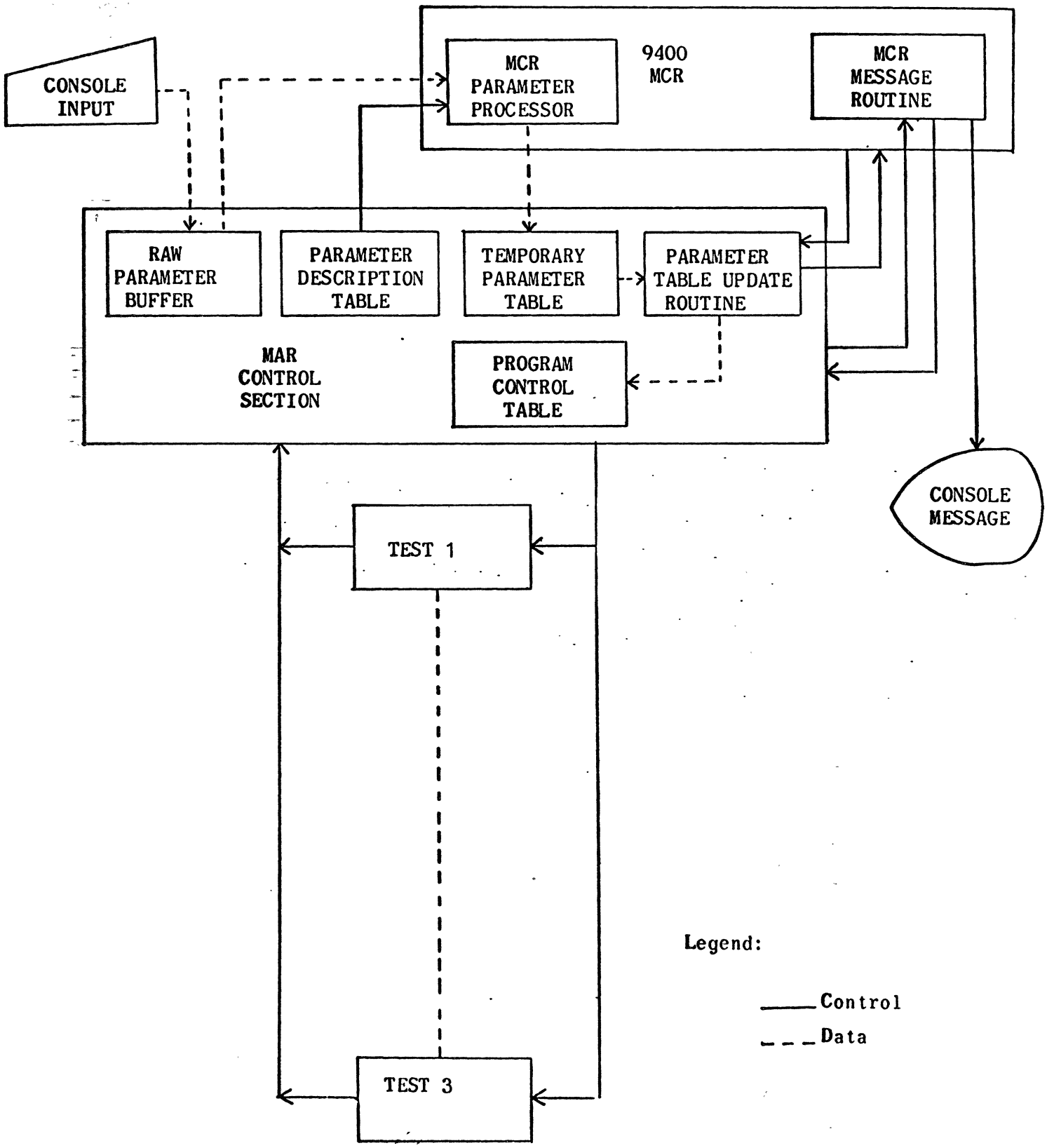
SENSE BYTE 2	MODE OF OPERATION		
BIT	DESIGNATION	PHASE-ENCODING	NRZI
0 ↓ 7	Track-in-Error	Not applicable - always set to zeros.	This sense byte contains the Track-in-Error Indicator bits that are set at the end end of a READ or READ BACKWARD operation if a Data Check has been encountered. A single 1-bit in any bit position indicates a single track error, the bit position indicates the track in error. Binary zeros in bits 0 → 7 implies Bit P. If Bits 6 and 7 contain binary ones, then a multiple track error has been encountered and no track error identification has been made. At the completion of a properly executed READ or READ BACKWARD operation with no Data Check, Sense Byte 2 contains at least Bits 6 and 7 set to 1's. No error correction is attempted when operating with 7-Track tape units. Bits 6 and 7 are set to 1's in Sense Byte 2.

SENSE BYTE 3		MODE OF OPERATION	
BIT	DESIGNATION	PHASE-ENCODING	NRZI
0	R/W VRC	A Vertical Redundancy Check occurred on a data frame when no marginal signal was detected in any track. (uncorrectable)	a. A Vertical Redundancy Check occurred on a data frame or CRC frame during a READ or READ BACKWARD operation. This indicator is not set after an Overrun indication. b. A speed check error occurred during a WRITE or WRITE TAPE MARK operation.
1	Multiple Dead Track Check-Track Start failure/LRC	a. A marginal signal orcurred in more than one track on a READ or READ BACKWARD operation. (uncorrectable) b. Valid information was not detected in at least one track while Read Checking the pre-amble during a WRITE operation. This indicates a track start failure, possibly indicating the track was never written on the tape. This check is only performed during the pre-amble before the circuits that detect marginal signal are operable. Normally Bit 4 of Sense Byte 3 will set in conjunction with this bit if the track is missing entirely.	A Longitudinal Redundancy Check occurred during a WRITE, WRITE TAPE MARK, READ or READ BACKWARD operation.
2	Skew	Excessive skew is detected during a WRITE, READ or READ BACKWARD operation. (Deskew register underflow.)	Excessive skew detected while read checking recorded data on a WRITE or WRITE TAPE MARK operation.
3	Post-amble Check/CRC	Set when the post-amble following the data is not read correctly.	A Cyclic Redundancy Check occurred during a READ or READ BACKWARD operation (9-Track only).

BIT	DESIGNATION	PHASE-ENCODING	NRZI
4	Dead Track-Check/W VRC	a. Indicates at least one track with marginal signal during WRITE or WRITE TAPE MARK operations. b. Indicates a marginal signal in only one track during a READ or READ BACKWARD operation (correctable error). This bit will not be set if a multiple track error occurs (see Bit 1). If I = 1 in the Read Command Code, and this bit is set, Data Check will set. However, if this bit is set and I = 0 in the Read Command Code, Data Check will not set. In either case, the data is correct. c. Indicates that a tape mark was not properly detected on the Read Check of a WRITE TAPE MARK operation.	A Vertical Redundancy Check occurred on a data frame or CRC frame during a WRITE or WRITE TAPE MARK operation.
5*	Tape Unit - 1600 bpi	The selected tape unit is set to 1600 bpi mode.	Same - this bit is always set to zero when selecting a 7-Track tape unit.
6*	Backward	The selected tape unit is conditioned for backward tape motion.	Same
7		NOT USED - always set to zero.	Same

SENSE BYTE 4		MODE OF OPERATION	
BIT	DESIGNATION	PHASE-ENCODING	NRZI
0	Runaway Check	a. While read checking recorded data during WRITE, or WRITE TAPE MARK operations, the end-of-block was not detected within at least 8.3 ms (UXII or UVI-C) or 2.9 ms (UXVI or UVIII-C) after writing has ceased. b. During all read-type operations, if data is not detected within at least 7.0 seconds (UXII or UVI-C) or 2.5 seconds (UXVI or UVIII-C).	Same
1	Tape Motion Fault	a. Tape unit failed to respond to a START Command. Tape motion may or may not have occurred. b. Tape motion stopped independently of the Control Unit during an operation requiring tape movement. (This condition will be detected if a BACKWARD operation is executed into load point.)	Same
2 ↓ 4	These bits are reserved for failure finding mode	———	———
5	Stall	Indicates that the Control Unit is hung up for more than 2.5 seconds.	Same
6	Tape Fault	During WRITE or WRITE TAPE MARK operations, indicates that the end-of-block was detected sooner than expected. False end-of-block can occur if a data dropout (all tracks) is longer than 790μs. on a UXII or UVI-C, or more than 280μs. on a UXVI or UVIII-C.	Same
7	This bit is reserved for failure-finding mode.	———	———

4.2.8 UNISERVO XII-C/XVI-C TEST BLOCK DIAGRAM -



4.2.9 Test Availability Table -

TESTBL -

Ø	Test Status	Assigned Device Table Address
4	Recovery Count	Initial Command Table Address

Where:

Test Status ØØ = Test Not Selected
Test Status 1Ø = Test Suspended
Test Status 2Ø = Test Finished
Test Status 4Ø = Test Running
Test Status 8Ø = Test Pending
Recovery Count = 3

4.2.10 Device Availability Table -

DEVTBL

Ø	Device Status	Device Address (Number)	Recovery Count
4	7-TRK OPTION	KIND NUMBER	

Where:

Device Status ØØ = Device Not Selected
Device Status 1Ø = Device Suspended
Device Status 2Ø = Device Finished
Device Status 8Ø = Device Pending
Recovery Count = Initially three (3)
7-TRK OPTION = 4Ø if 7-TRK, ØØ if 9-TRK

4.2.11 Register Allocation -

RØ, R1 } communication with MCR and PMR
R2 - First level links
R3 - Second level links
R4 - General Purpose (contains repeat count in Timing Mode).
R5 - General Purpose (contains return address in Timing Mode).
R6 - Subtest table Pointer
R7 - Device table Pointer

R8 - Command Table Pointer

R9 - 12 - General Purpose

R13 - 15 - -Base Registers

4.2.12 Program Constants/Variables - The following is a list and description of the various constants/variables used by this test program in its calculations:

Label	Value	Description
LPTM	31.8 µsec	Program loop time while waiting for first byte to enter memory.
CNTIM	Variable	Accumulated LPTM time.
INT12	1Ø6Ø.Ø µsec	UNISERVO 12 initial delay time. Equal to MCR delay (8Ø.4 µsec) plus program delay [189.6 µsec or 253.6 µsec (for Read Backward)] plus hardware delay (79Ø µsec).
INT16	55Ø.Ø µsec	UNISERVO 16 initial delay time. Equal to MCR delay (8Ø.4 µsec) plus program delay [189.6 µsec or 253.6 µsec (for Read Backward)] plus hardware delay (28Ø µsec).
CNTHLD	Variable	Total of CNTIM and INT12 or INT16 time.
NSITIM	171.Ø µsec	Fudge time for console interrupt. Equal to MCR delay (121.8 µsec) plus program delay (49.2 µsec).
LOOPTM	52.2 µsec	Time needed to make one loop in the variable time Subroutine (VARDLY).
DELAY1	2949.2 µsec	Time needed to start the 3.2 millisecond variable delay. The difference (32ØØ.Ø-2949.2) is equal to MCR delay time (8Ø.4 µsec) plus program delay time needed to get back to the variable delay subroutine (17Ø.4 µsec).
AMBLE1	213.5 µsec	Time needed by the UNISERVO 12 to traverse the pre-amble in the phase recording mode.
AMBLE2	6ØØ.1 µsec	Time needed by the UNISERVO 16 to traverse the pre-amble in the phase recording mode.
SPEED1	42.7 in/sec	UNISERVO 12 Tape Speed.
SPEED2	12Ø.Ø in/sec	UNISERVO 16 Tape Speed.
DLYINC	1Ø4.4 µsec	Increment or decrement used in Subtest 3.

Lable	Value	Description
BACKTM	64.2 µsec	Time needed to be added to INT12 or INT16 if a read backward is being performed.
TIMHLD	Variable	Contains accumulated variable delay time (3.2 milliseconds plus n x 1Ø4.4 µsec).